B 771517

VOLUME 43 • NUMBER 247 May 1959

408100
408105
MAY - 6
THE LIBRARY OF CONGRESS SERIAL RECORD
MAY 9 1959

THE Bulletin

OF THE NATIONAL ASSOCIATION OF SECONDARY-SCHOOL PRINCIPALS

New Developments in Secondary School Mathematics

SERVICE ORGAN FOR AMERICAN SECONDARY SCHOOLS

THE CONTENTS OF THIS BULLETIN ARE LISTED IN "EDUCATION INDEX"

Second-class postage paid at Washington, D.C., and at additional mailing offices.

NATIONAL ASSOCIATION OF SECONDARY-SCHOOL PRINCIPALS

A Department of the
NATIONAL EDUCATION ASSOCIATION
1959-60

OFFICERS

President: CLIFF ROBINSON
Director of Secondary Education, Eugene Public Schools, Eugene, Oregon
First Vice President: JAMES E. NANCARROW
Principal, Upper Darby High School, Upper Darby, Pennsylvania
Second Vice President: JAMES D. LOGSDON
Superintendent-Principal, Thornton Township High School and Junior College
Harvey, Illinois
Executive Secretary: PAUL E. ELICKER
1201 Sixteenth Street, N. W., Washington 6, D. C.

EXECUTIVE COMMITTEE

All officers and the following additional members:
EUGENE S. THOMAS
Principal, Central High School, Kalamazoo, Michigan
CALLOWAY TAULBEE
Principal, Artesia Senior High School, Artesia, New Mexico
JOHN M. SEXTON
Principal, Northeast High School, St. Petersburg, Flordia
SAMUEL M. GRAVES
Principal, Gamaliel Bradford High School, Wellesley, Massachusetts

NATIONAL COUNCIL OF THE NATIONAL HONOR SOCIETY

ROBERT L. POOSE, *Chairman*
Principal, Westfield Senior High School, Westfield, New Jersey
RICHARD F. GOOS
Principal, Roosevelt Junior High School, Hamilton, Ohio
HOWARD F. HORNER
Principal, David Douglas High School, Portland, Oregon
GEORGE W. JANKE
Principal, Mitchell High School, Mitchell, South Dakota
SISTER MARY KILLEEN, O.P.
Principal, Edgewood High School of the Sacred Heart, Madison, Wisconsin
DRAYTON E. MARSH
Principal, Culver City Junior High School, Culver City, California
F. D. MOON
Principal, Douglass High School, Oklahoma City, Oklahoma
H. S. SHEARHOUSE
Director, Division of Instruction, State Department of Education, Atlanta, Georgia
W. EUGENE SMITH
Principal, Orangeburg High School, Orangeburg, South Carolina
PAUL E. ELICKER, *Secretary*

$3.00 a Year — Issued Nine Times a Year — $1.50, Postpaid
Monthly, September to May Inclusive

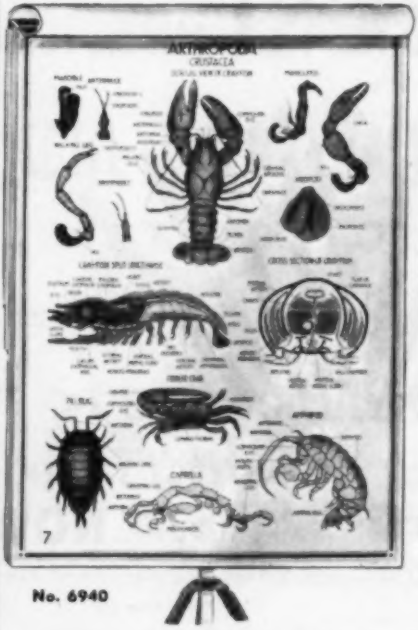
Published at Washington, D. C., by the National Association of Secondary-School Principals of the National Education Association, 1201 Sixteenth Street, N.W., Washington 6, D. C.

B 771517
MAY -6 1959

MODERN METHODS DEMAND THE USE OF VISUAL AIDS

L13
.N27

Welch Smallwood—BIOLOGY CHARTS



No. 6940

in Diagrammatic Colors

SIZE 24 x 36 inches

Up-to-Date
Easy to Understand
Non-Glare-Washable
Protective Coating

30 ZOOLOGICAL CHARTS with more than 350 drawings

30 BOTANICAL CHARTS with more than 400 drawings

No. 6939—Botanical Charts set of 30 tripod or wall bracket mounting **Per Set $27.50**

No. 6940—Zoological Charts set of 30 tripod or wall bracket mounting **Per Set $27.50**

No. 6941—Biological Charts set of 60—combined set of 30 Botanical and 30 Zoological charts in wall bracket or tripod mounting **Per Set $45.00**

Have Your Science Instructor Write for our Charts and Models Catalog.

W. M. WELCH SCIENTIFIC COMPANY

DIVISION OF W. M. WELCH MANUFACTURING COMPANY

Established 1880

1515 Sedgwick Street **Dept. G-1** **Chicago 10, Ill., U.S.A.**

Manufacturers of Scientific Instruments and Laboratory Apparatus

INDIANA PENCIL COMPANY

NEW CASTLE, INDIANA

NOW SUPPLYING GOOD BALL POINT PENS AT VERY LOW PRICES!

NOT 39¢

NOT 29¢

NOT 25¢

BUT 15¢ SUGGESTED RETAIL PRICE

(EQUAL IN VALUE TO ABOVE PRICE PENS)

YOUR COST . . . **10¢** WE PAY SHIPPING

YOUR NET PROFIT . . . **5¢**

GIVE YOUR STUDENTS A REAL BUY . . . NOW

RETRACTABLE BALL POINT PEN

With Pocket Clip

ATTRACTIVE TWO-TONE ASSORTED COLORS

•

SAMPLE PEN SENT ON REQUEST

Don't Delay!

FILL IN THE COUPON TO GET THIS BARGAIN

Prices Guaranteed to June 1, 1959

ORDER BLANK — CUT ON LINE

INDIANA PENCIL CO., INC.
NEW CASTLE, INDIANA

Date _____

PLEASE SEND US _____ RETRACTABLE BALL POINT PENS

(Attractive Two-Tone Assorted Colors)

MINIMUM ORDER . . . . . 100 @ 10c Each ($10.00) - Delivered

Ship To: _____

_____

_____

_____ Signature _____ Title

A-E-20

ORDER NOW!

THE 1959 EDITION

OF

The College Blue Book

IS READY FOR PRINTING

WE ARE ACCEPTING

PRE-PUBLICATION ORDERS

POST-MARKED NOT LATER THAN MAY 31

at $18.00 per copy

($15.00 CASH — WITH ORDER)

(Two printings of the 8th Edition were completely sold out and many orders could not be filled. Tenth Edition is scheduled for 1962.)

Use the Convenient Order Card

INSIDE BACK COVER

Mathematics in Secondary Schools Today

REPORTS on curriculum changes being proposed, the problems of general education in mathematics, provision for the student talented in mathematics, articulation between elementary and secondary-school programs, evaluation, and teacher education.

Planned and prepared under the guidance of a committee of the National Council of Teachers of Mathematics, a Department of the National Education Association.

COMMITTEE MEMBERS

MRS. IDA BERNHARD PUETT, formerly *Consultant in Secondary Education*, Texas Education Agency

ROBERT S. FOUCH, *Supervisor of Mathematics and Science*, Maplewood Public Schools, Maplewood, New Jersey

L. CLARK LAY, Pasadena City College, Pasadena, California

MYRON F. ROSSKOPF, *Professor of Mathematics*, Teachers College, Columbia University, New York, New York, CHAIRMAN

EUGENE P. SMITH, *Supervisor of Mathematics*, Dover, Delaware

Preface

MUCH has happened both in the world at large and the world of mathematics education since the appearance in May 1954 of the Mathematics Number of the NASSP BULLETIN. True, there was concern at that time with the mathematics program, but the concern was not so urgent then as it now seems.

Five years later, a cross-section of people interested in the mathematics program—from colleges, from supervisory positions, and from classrooms—have prepared another report whose purpose is to acquaint the members of the National Association of Secondary-School Principals with what has been done.

There are some features of this report that are worth commenting upon. *One* is the appearance again and again of the assertion that advances in the field of mathematics and in technology have been so rapid during the last quarter century that it is no longer possible to plan an educational program on the basis of preparation for life. We do not know, nor can we predict with any degree of certainty, what that life may be like! A *discontinuity* in education will appear; the only sort of preparation in mathematics that seems sensible, therefore, is one that stresses concepts basic to mathematics today. Skills needed may disappear entirely or change, but concepts are likely to be needed at any future date. Furthermore, a student who has well-developed mathematical concepts is more adaptable to the sort of life he might meet in *his* future.

A *second* feature worth commenting upon is the assurance with which the writers speak of their chosen field. For the first time in the teaching career of the writer, he is living in an era when it is a proud thing to be teaching mathematics. It seems that the importance of subject matter is being reasserted in mathematics and science. Groups of diverse origin are speaking authoritatively about the secondary-school mathematics program. And these groups are not only outlining a program; they are preparing materials to go with—to implement, if you please—their programs.

Third, it is clear that evaluation is making and has made great strides forward. More and more, people want data concerning a student's ability to solve a problem in a "free" situation. Skills are taken for granted; after all, a school tests these thoroughly in its classrooms. But what can the candidate do when he is faced with a strange problem in an unfamiliar setting? Can he apply, adapt, modify the principles he knows and achieve a solution of the problem posed?

Lastly, teacher education receives a hard look. It appears that mathematics teachers have done very little studying in the past after earning certification. The new programs require learning some new mathematics. Pre-service teacher education must change in order to achieve greater depth in mathematics and science for the teacher neophyte. What will give way to make room for the increased hours in mathematics?

MYRON F. ROSSKOPF, *Chairman,*
Editorial Committee for the
Mathematics Issue of THE
BULLETIN *of the National*
Association of Secondary-
School Principals.

Volume 43 • Number 247
May 1959

The Bulletin
OF THE NATIONAL ASSOCIATION OF
Secondary-School Principals

This Association does not necessarily endorse any individual, group, or organization or the opinions, ideas, proposals, or judgments expressed at the annual convention of the Association, and/or published in THE BULLETIN.

TABLE OF CONTENTS

NEW DEVELOPMENTS IN SECONDARY SCHOOL MATHEMATICS

Page

Preface 1

CHAPTER I

New Programs in Secondary School Mathematics

Efforts To Improve Programs and Teaching in Mathematics ... J. R. Mayor 5
A Secondary School Mathematics Program ..... M. E. McCoy 12
Proposals of the Commission on Mathematics of the College Entrance Examination Board ..... A. E. Meder, Jr. 19
The School Mathematics Study Group ..... E. G. Begle 26

CHAPTER II

Mathematics for a Liberal Education

Mathematics in General Education ..... H. P. Fawcett 32
Problems of Mathematics in the Small High School ..... M. W. Beckmann 37
Experiences with Some Different Topics for Slow Learners ..... Stephen Krulik 43
A General Mathematics Program for a Large High School ..... I. A. Ostrander 46
The Place of Mathematics in a Liberal Education ..... W. H. Glenn 51
A Look at a Multiple Track Mathematics Program ..... H. L. Gallant 55
A Junior High School Principal Views Mathematics in a Liberal Education ..... D. W. Lentz 60

CHAPTER III

Students Talented in Mathematics

Mathematics and the Gifted Student—Some Problem Areas ... A. H. Passow, D. J. Brooks, Jr. 65
Gifted Students in Senior High School Mathematics ..... Frances Freese 71
The Rice Institute Summer Program for Talented High School Students ..... L. K. Durst 74

(*Continued on next page.*)

THE CONTENTS OF THIS BULLETIN ARE LISTED IN "EDUCATION INDEX"

Issued Monthly, September to May Inclusive

Copyright 1959 by

THE NATIONAL ASSOCIATION OF SECONDARY-SCHOOL PRINCIPALS

PAUL E. ELICKER, Executive Secretary

PAUL E. ELICKER, Editor — WALTER E. HESS, Managing Editor

WALTER E. HESS, Associate Secretary for Publications
ELLSWORTH TOMPKINS, Associate Secretary for Administrative Services
G. EDWARD DAMON, Assistant Secretary for Business
COLBURN E. HOOTON, Assistant Secretary for Student Activities
GERALD M. VAN POOL, Assistant Secretary for Student Activities

1201 Sixteenth Street, N.W., Washington 6, D. C.

Page

The JvN Memorial Mathematics Summer Seminar for Talented High School Students — D. E. Edmondson — 77
The Seattle Project for Talented Students — Elizabeth Roudebush — 78
Mathematics at the Bronx High School of Science — I. A. Dodes — 81
The University of Maryland Project and Talented Students — M. L. Keedy — 84
Ohio State University Works with Talented High School Seniors — P. V. Reichelderfer — 86
Meeting the Needs of Cincinnati's Gifted Pupils in Mathematics — Mildred Kieffer — 89
The Advanced Placement Program of the CEED — E. C. Douglas — 92
A Junior High School Seminar for Talented Students — F. L. Elder — 95
A Demonstration Class in a National Science Foundation Summer Institute — H. F. Montague — 98
A Summer Mathematics Camp for Talented High School Students — E. D. Nichols — 100
A Mathematics Field Day — M. R. Kenner — 103

CHAPTER IV

Articulation Between Elementary and Secondary Schools

The Importance of Articulation — P. S. Jones — 107
Mathematics as a Man-Made Invention in the Elementary Classroom — M. V. DeVault — 111
The Supervisor, the Teacher, and Articulation Between Elementary and Junior High Schools — R. R. Smith — 114
Concepts Providing Elementary and Secondary Mathematics — H. Van Engen — 116
Providing for Individual Differences by Grouping in Depth — R. L. Morton — 119
Wise Use of Materials and Devices — F. E. Grossnickle — 122
Evaluation of Student Learning in Secondary School — J. J. Kinsella — 125
Evaluation of Learning in Arithmetic — L. K. Eads — 128
Articulating Geometry Between the Elementary and Secondary Schools — A. C. Peters — 131
Evaluation in Arithmetic and Talented Students — V. J. Glennon — 134
Are We Sure Learning Has Taken Place? — E. G. Gibb — 136

CHAPTER V

Mathematics and Educational Television

The Production and Presentation of a Televised Mathematics Program — J. R. Hooten, Jr. — 140
Teaching Algebra *via* Television — D. W. Wells — 144
Explaining a Mathematics Program to Parents *via* Television — Louis Scholl — 147

CHAPTER VI

Mathematics and Evaluation

A New Approach to Evaluation of Comptence — S. S. Myers — 150
What Can the Classroom Teacher Do About Evaluation? — D. A. Johnson — 154
Mathematics Evaluation in a Large City — M. C. Cliffe — 161
Evaluation in a Large State: New York Regents Examinations — F. S. Hawthorne — 165

CHAPTER VII

The Mathematics Teacher, Present and Future

The Education of Teachers of Mathematics — H. F. Fehr — 169
The Commission on Mathematics of the CEEB and Teacher Education — R. E. K. Rourke — 173
Academic Year Institutes — B. W. Jones — 179
Industry Lends a Hand — G. A. Reitz — 181
A University Assists in an In-Service Program — Robert Davis — 187

* * * * *

The Undergraduate Achievement of National Merit Scholars and Certificate of Merit Winners — J. L. Holland — 190
The Administrator and the Conant Report — D. B. Austin — 193
Best Books of 1958 on Vocational Guidance — Robert Hoppock — 203
The Book Column — 209
News Notes — 261

Chapter I

New Programs in Secondary School Mathematics

Efforts To Improve Programs and Teaching in Mathematics

JOHN R. MAYOR

SCIENTISTS are now convinced that science has entered a new era in which the pace of scientific progress will be very great. Some scientists even suggest that scientific progress of the next two decades will bring about a discontinuity in the history of human experience, perhaps the greatest discontinuity of all times. This brings us face to face with the realization that we are trying to prepare boys and girls in our schools for a life we do not know and cannot, at this time, predict. Always before in education, we were trying to prepare students for a life which we could predict.

When one recognizes these almost certain changes in our way of life for the future, he does not question that it is essential for the best minds among teachers and researchers at all levels to give immediate and direct attention to efforts to improve school programs in all disciplines but especially in science and mathematics. The debate over the quality of the schools and the degree of our successes or failures in education does not first need to be resolved, in the light of future demands for the best possible education we can possibly provide. It is in this spirit that the new programs in mathematics and science must be considered. It is a widely held point of view among scientists and leaders in Government and industry that if we are to meet the challenge of the future in science and mathematics education, there must be developed new programs of science and mathematics which will be more challenging to all students, which will make a better contribution to general education, and which will enable at least the upper 50 per cent to progress more rapidly during secondary-school and college years.

The Other Sciences

Of science curriculum groups, the Physical Science Study Group (PSSG), with headquarters at the Massachusetts Institute of Technology,

John R. Mayor is Director of Education, American Association for the Advancement of Science, Washington, D. C.

has probably received widest recognition. For the past two years this group has been concerned with the development of an entirely new course in *physics* as a first-year course. This course is being tried out in some 300 schools during the academic year, 1958-59. The PSSG engaged not only in the production of a first-year physics text, but also in the invention of new and better laboratory equipment, including improved techniques for the use of films and filmstrips. The Pittsburgh public schools, with the assistance of a physicist from the University of California, produced an entire high-school physics course on film which is now sold (at a considerable cost) by a commercial distributor. These films are being tried out in classrooms both with and without teachers in Wisconsin and Oklahoma under grants made for this purpose by the Ford Foundation.

The American Chemical Society is sponsoring the production of a high-school *chemistry* course on films which will likewise be available through a commercial distributor. This work is being carried on at the University of Florida. During the past few years, several of the biological societies have sponsored summer workshops in which text and laboratory material for *biology* classes have been prepared. These workshops have involved research biologists as well as those recognized for competence in teaching. At this date in writing, the biological sciences have not undertaken any comprehensive study of content and organization of biology courses.

There is a growing concern about the need for a comprehensive study of the total science curriculum from kindergarten through college in relation both to grade level and to the sciences to be included. Even those most enthusiastic about the national studies in the separate sciences of physics, chemistry, and biology are of the opinion that someone needs to be concerned about the place of the other sciences such as geology, astronomy, anthropology, and psychology in the science programs of the elementary, secondary school, and college.

Historical Background

For nearly 300 years mathematics has played an important role in American education. Yet, among the unsolved problems of mathematics education are those of clearly defining this importance and of determining the relative value of mathematics to other subjects as well as its relative value for students of greatly varying aptitude and interests. More than for any other subject, there has been developed and maintained for mathematics a traditional sequence in which topics are to be studied. However, there is little experimental evidence to support the choice of this or any other particular sequence. Not until the middle of the twentieth century has this sequence been seriously challenged. Even now there is much too little basic research planned to answer questions about level of mental maturity appropriate for the study of particular mathematical concepts, effective means of motivating interest in the study of mathematics or of testing to see if this interest exists.

What is known as elementary-school arithmetic has from the beginning been a part of formal instruction and has remained the basic part of mathematics through the elementary school and even into junior high school. Geometry and algebra, first taught in the colleges, were given a place in the secondary schools during the latter half of the nineteenth century. During that period these subjects were generally required of all students. A pattern of one year of algebra followed by one year of plane geometry (Euclidean geometry) no doubt grew from the practice of teaching two years of mathematics in grades 9 through 12 of the secondary school. There have been numerous attempts within individual school systems to develop integrated courses in arithmetic, algebra, and geometry, but there has been no demonstration convincing enough to bring about wide acceptance of such deviations. It must be admitted that a resourceful teacher could use a translation of Euclid's Elements, written more than 2,000 years ago, and with appropriate mimeographed exercises meet the course syllabus requirements in most tenth-grade geometry classes in America today.

Mathematics Curriculum Studies of this Decade

In recent years however, to a greater extent and for a longer period than in the other sciences, there has been in mathematics much effort directed toward modernization of the curriculum. This effort has from the beginning involved competent persons, who have won recognition both for their contributions to mathematical research and their success as teachers of mathematics. With the organization in the summer of 1958 of the School Mathematics Study Group, centered at Yale University, there promises to be a greatly expanded effort in the development of new programs in mathematics.

Since the founding of the *College at the University of Chicago*, the mathematics department of the College has been concerned with the development of a modern and basic course in mathematics for general education. The course now in use which has gone through frequent revision, involves many of the ideas with which other of the curriculum groups are now working. The experience at the University of Chicago has been of great value and will continue to be of value to all efforts to modernize the mathematics curriculum.

An important contribution to the improvement of secondary-school curriculum in mathematics has been made by the program for the *Admission to College with Advanced Standing*. As a reaction to the criticisms which resulted from the establishment of fellowships in universities for sixteen-year-old students who had completed two years in high school, this program was developed to enable the most competent students to remain in high school and yet to complete some of the traditional work at the college level. The Commission responsible for the initiation of this program developed high-school sequences in the several disciplines with the assistance of wide discussion by scholars and

teachers. These sequences are gaining acceptance in high schools throughout the country. The College Entrance Examination Board now provides tests on which university credit or advanced standing may be granted.

For about five years the Mathematical Association of America has sponsored a *Committee on the Undergraduate Program*. The Committee has considered ways to (1) bring to freshmen the calculus, (2) introduce to them set notions and probability theory, (3) and to do this without imposing unrealistic demands on students with two and one-half years of mathematics in high school. The Committee has designed two types of sophomore courses. One of these is for physical science and engineering majors, and the other is intended to answer increasing demands from the biological and social sciences.

The College Entrance Examination Board established the *Commission on Mathematics* to consider broadly the secondary-school college-preparatory mathematics curriculum and make recommendations on its modernization and improvement. The Commission recommends that a full secondary program prepare the student for the study of calculus in the freshman college year. In its work the Commission has prepared sample textbook materials on probability and inferential statistics to be used in the senior year. The Report of the Commission was issued in the fall of 1958.

The widely publicized *University of Illinois Project* for the Improvement of School Mathematics involves the University's College of Education and Engineering and the Department of Mathematics. This Project is planned to create a four-year program in college preparatory mathematics in the manner of contemporary mathematicians. The courses prepared are now being tried out in quite a number of schools in several states. A stronger program has resulted from periodic revision after tryout of the materials.

In September 1957, a Study of Junior High School Mathematics was inaugurated at the *University of Maryland*. Under this Study, the four major school systems of the Washington area and Maryland engineering, psychology, and education staff members are working cooperatively. The Advisory Committee for the Study also includes representatives of the Maryland State Department of Public Instruction and the U. S. Office of Education. Associated with the development of the experimental courses for grades 7 and 8 are psychological studies intended to determine how children of this age level think about mathematics, measures of mental maturity for the study of certain mathematical concepts, and a rather extensive evaluation of achievement with the experimental materials in comparison with the traditional materials.

No attempt will be made to review the comprehensiveness of the program of the *School Mathematics Study Group* (SMSG), centered at Yale University, since its work was only in beginning stages at the time of this writing. The first attention of the Group is to be given to the mathematics

program of grades 7 through 12. It is planned that work on sample textbooks for grades 9 through 12 be started at an early date, and that, after tryout of experimental materials for grades 7 and 8, sample texts also be prepared for these grades. SMSG will give attention to possibilities for teaching by films, both for students and teachers, and to problems of teaching by television. The program also calls for preparation of an extensive series of monographs.

The Carnegie Corporation of New York has provided *financial support* for the Commission on Mathematics, the University of Illinois, and the University of Maryland studies. The Ford Foundation assisted the Commission on Admission to College with Advanced Standing and both Ford and the National Science Foundation gave assistance to the Mathematical Association's Committee on the Undergraduate Program. Initial support to the School Mathematics Study Group centered at Yale University has been provided by the National Science Foundation.

The Secondary-School Curriculum Committee of the *National Council of Teachers of Mathematics* has been organized with ten subcommittees, each of which is expected to issue a preliminary report this spring. The committee, in giving its attention to the mathematics program for *all* students, grades 7 through 12, is in a strategic position to all of the current curriculum investigations, to interpret for teachers and schools recommendations of other groups, and to bring about acceptance by schools and teachers of sound proposals of all other groups.

The *Social Science Research Council* has recently published two statements of recommended policies for the mathematical training of social scientists.[1] A report on the teaching of mathematics for engineers has been issued by the joint committee of the *American Society for Engineering Education* and the *Mathematical Association of America*.[2]

At the date of writing much too little attention is being given by scientists and teachers to the mathematics of the *elementary grades*. There is, however, some progress at this level. The National Council of Teachers of Mathematics has named an elementary-school curriculum committee. The Carnegie Corporation of New York has made several small grants to individuals for exploratory studies. The Council for Basic Education has sponsored a comparative arithmetic study which was scheduled for publication in the fall of 1958. The study involves a fairly extensive comparison of European and American textbooks in arithmetic. Textbooks and programs of nineteen European countries were examined in the study.

Many states publish curriculum bulletins, including special bulletins on mathematics, which are developed to serve as guides to course and content selection. Conformity with these bulletins, however, is rarely

[1] *Items*, Vol. 9, No. 2, June 1955: "Recommended Policies for the Mathematical Training of Social Scientists." Also *Items*, Vol. 11, No. 4, December 1957: "Activities of the Committee on Mathematical Training of Social Scientists, 1952-57, and Suggestions for the Future."

[2] *Journal of Engineering Education*, Vol. 45, No. 8, April 1955.

required for schools within the state. Larger city and county school systems often prepare their own course guides. These guides have been in considerable part influenced by reports of national committees and commissions and of course will continue to be. Their effectiveness is determined by the availability of appropriate texts. A curriculum bulletin of the late forties, which served as a model for many others, was published by the District of Columbia schools. California, Oklahoma, and Wisconsin have recently prepared new state guides which reflect in part the "new programs" in mathematics.

Because of the numerous efforts for the improvement of mathematics curriculum, the American Association for the Advancement of Science sponsored two *Conferences on Mathematics Instruction* during the academic year of 1956-57. The participants in the Conferences included not only those who have won recognition for research in mathematics and for competence in teaching mathematics, but also representation from the major scientific societies in biology, chemistry, physics, and psychology. The Conferences were concerned with the studies in mathematics curriculum. It was recommended by the Conferences that attention be given to the elementary-school and junior high-school levels and the need for research in learning mathematics especially in problems of student motivation and questions of readiness. It was proposed by the Conferences that there be established one central agency to which information would be available on the curriculum studies in all of the sciences.

Some Answers to Apprehensions

Various groups have expressed varying degrees of apprehension about "what is going on in mathematics." Those concerns may be categorized as follows:

1. That the new programs are too abstract and will not provide the most efficient preparation for the other sciences and engineering.
2. That the studies should have started at the elementary level, or at least be concurrent with elementary-level studies.
3. That teacher education programs even in 1958-59 are not preparing teachers to teach the new materials.

All of these have some basis for support, but, combined, these bases do not appear to be sufficient to detract from the apparent progress toward sound programs that is being made. Planning for the new School Mathematics Study Group already gives promise of directly alleviating any shortcomings due to these causes.

The various programs have of course differed in degree in abstraction, but the concern of all of the studies for providing materials which pupils can learn by discovery and which in their emphasis on broad and underlying concepts should make understanding more within the grasp of the pupil is an important safeguard. There is no reliable evidence that the learning of abstract concepts, which is interesting and often exciting,

will not enable the learner better to understand basic concepts and in turn be better able to apply the needed mathematics in appropriate situations.

While it is to be hoped that work at the elementary-school level is soon to be greatly increased, there is no doubt that the current emphasis on the secondary-school level and resultant improvement will have a salutary effect on the teaching in the elementary grades even though no attention is given directly to this level. Parents of pupils in an experimental program at the seventh-grade level raised questions about the desirability of a "new program" in grade 7 when that which precedes in earlier grades remains traditional. It is pleasing to find the parents asking how one can be sure that the new topics should not have been taught at an even earlier level.

While the summer institute programs are making a major contribution to reteaching inservice teachers, there is not much evidence that undergraduate mathematics teacher education programs are being "modernized" at a sufficiently rapid rate to keep up with secondary-school curriculum developments. This is of course no argument against the new programs. Rather it provides a call to colleges to see that needed revisions are made immediately.

The current widespread activity and interest in the development of new programs in mathematics naturally causes some present confusion for schools and teachers as they try to decide what is best for this year or next. Even state-wide curriculum committees in mathematics are presented with the dilemma of going ahead with their own curriculum studies or of waiting until the recommendations of the broader national groups, groups with much greater financial resources, are available. It is already clear to teachers that their undergraduate or graduate preparation in mathematics does not now equip them for the recommendations which are almost certain to be forthcoming. Nevertheless, all school people should rejoice that top-level scientists and pre-college level teachers are joining forces in a major way to plan better learning experiences in mathematics for all of the school and college years. City and regional groups of teachers might well be organized to study concepts of mathematics which appear to be of special significance for courses in secondary school and college. This can become an exciting experience. The new programs in mathematics which we will be teaching in the next ten years also promises to be exciting for teacher and pupil.

A Secondary School Mathematics Program

M. ELEANOR McCOY

SINCE 1952, the University of Illinois Committee on School Mathematics[1] has been working on materials of instruction, developing teaching methods, and training teachers for a new curriculum in mathematics for the secondary school. The UICSM has developed students' texts and teachers' guides for the four high-school grades; these were used during 1957-58 in twelve pilot schools by forty teachers and about 1700 students.[2] During the 1958-59 school year some thirty-three additional schools have participated to the extent of offering *First Course*. Most of the students who take the UICSM *First Course* are those who would ordinarily be enrolled in conventional ninth-grade "college preparatory" mathematics courses; in a few cases, gifted eighth-grade pupils [and highly gifted seventh-grade pupils] are studying *First Course*.

The Project was undertaken because of the belief that improvement was necessary in the secondary-school mathematics curriculum. Too often there is little connection between the view of mathematics which the student finds in conventional courses and the views of contemporary mathematicians. Also, the conventional courses too frequently give the student the feeling that mathematics is a rather dull game, with many and varied rules which sound inconsistent; hence not enough students become sufficiently interested in mathematics to want to pursue its study beyond the ninth or tenth grade.

Furthermore, the UICSM believes that it is possible to develop materials of instruction, and to train high-school teachers in their use, so that the youngsters using the materials become enthusiastic students who *understand* mathematics.

This two-fold task—developing materials and training teachers—which the Project staff set for itself is still being carried on. The curriculum materials, though some portions have been used for as many as three years, are still being revised; in some areas entirely new units are being written. The teacher-training aspect of the Project continues also through the media of summer workshops and institutes, week-end conferences at the pilot schools and at the Project center in Urbana, and personal consultation with the teacher coordinators and other members of the Project staff.

In the early years of the Project, the writing staff asked themselves such basic questions as: "What is a number?" "What is a variable?"

---

[1]Portions of the material in this article appeared in a similar article published in the *School Review*, Vol. 65, Winter 1957; other portions are taken from the Inglis Lecture given by Dr. Max Beberman at Harvard University on March 19, 1958.

[2]Since 1956, the Project has been supported largely by a grant from the Carnegie Corporation of New York.

M. Eleanor McCoy is Teacher Coordinator of the University of Illinois Committee on School Mathematics, Urbana, Illinois.

"What is a function?" Treatment of these questions in most conventional texts is far from satisfactory, and a mere reshuffling or integration of traditional content will not supply answers to them. Nor will a reshuffling of conventional content forestall the all-too-common notion among adolescents that mathematics is dull and divorced from common sense. The writing staff has three major theses: (1) that a consistent exposition of high-school mathematics is possible; (2) that high-school students are greatly interested in ideas; and (3) that manipulative tasks, though necessary, should be used primarily to cast light on basic concepts.

In the attempt to develop a program in accord with these propositions, some ideas from "modern" mathematics were introduced; but more concern was given to consistency than to up-to-dateness. And, to cope with this problem of consistency, advice from contemporary research mathematicians (particularly those concerned with logic and the foundations of mathematics) was sought. The experience with the materials written for these early units indicated that contemporary mathematics contains much that is both interesting and valuable for high-school students; it also indicated that many high-school teachers, though not prepared academically to teach these newer concepts, *can* do so when given the right kind of help both in understanding these ideas and in teaching them.

Furthermore, as experimentation continued, it became evident to the curriculum makers that there were two primary considerations to keep in mind in the development of the courses. These considerations were: (a) that the language of textbook and teacher be made as unambiguous as possible; and (b) that discovery of generalizations by the student be encouraged and fostered. Indeed, these considerations are so important in implementing the ultimate goal of the Project—development of a curriculum and teaching method that will insure a crop of students who are *enthusiastic* about, and who *understand*, mathematics—that further explanation of them in this article seems advisable.

Preventing Ambiguity

In developing precision of language in UICSM courses, a distinction is made between things and their names at the very beginning of the ninth-grade course. This is done by considering names of persons ['John,' 'Mary,' 'Stan'] and of things ['table,' 'cake,' 'dog'] which can be written on paper or on the blackboard, and then raising the question as to whether the marks on the paper or blackboard are the things themselves. Students quickly realize that there *is* a difference between the name and its referent. Then the discussion proceeds to a consideration of numbers, and the marks [numerals] we write when we want to mention numbers. The students are asked: "Is the word 'honesty' the same thing as the idea we have in our minds when we decide that some person is known for his honesty?" "Is the mark '8' which we may write on the board really the number 8?" Talking about these issues leads students to realize that

there is a difference between numbers and number symbols, and that it would be helpful to have some way of indicating in our written work when we are talking about symbols, and when we are talking about their referents. The convention used for this in UICSM texts is that commonly used by logicians; a word or symbol is enclosed in single quotation marks when we want the reader to think about the word or symbol rather than its referent. Thus, we might write: "The answer to the problem of multiplying 972 by 10 is obtained by putting a '0' at the right end of '972.'" Again, we might write: "'$3+5$,' '$16\div 2$,' '$9-1$,' '8' and 'eight' are all numerals [names] for the 8." When this distinction between numbers and their numerals becomes clear to the students, it is easy for them to understand that each number has many numerals, and that in some problems which they are asked to do, one numeral may be more helpful than another. For example, when the student is asked to find the sum of $\frac{4}{5}$ and $\frac{1}{3}$, he might write: $\frac{4}{5}+\frac{1}{3}$, but he realizes that this expression may not be as useful as another. Suppose, for instance, his purpose is to compare the above-mentioned sum with 1. He knows that he can write $\frac{\text{'12'}}{15}$ for $\frac{\text{'4'}}{5}$ and $\frac{\text{'5'}}{15}$ for $\frac{\text{'1'}}{3}$ since in each case these are numerals for the same number. The number $\frac{4}{5}+\frac{1}{3}$ may then be symbolized by: $\frac{12}{15}+\frac{5}{15}$, and a simpler-looking numeral for this number is $\frac{\text{'17'}}{15}$.

This distinction between things and their names is essential in preparing the student for a consistent and simple explanation of the use of letters in mathematical expressions.

A student who thinks that a numeral is a number can be quite disturbed when he reads that a letter is a number also. The statement found in many conventional texts that "a letter is a symbol for a number," creates considerable confusion in the mind of a student who tries to understand the use of letters in sentences such as:

$$x+5=8, \qquad x+7=11, \qquad \text{and} \qquad x^2-1=35.$$

He is told that in the first sentence, 'x' stands for 3, that the second 'x' stands for 4, and that the third 'x' stands for 6 and -6!

The student may also be told in a conventional course that he can add 3a and 4a, but not 3a and 4b, although he could multiply each of these pairs if he wished. Furthermore, he learns that he can identify -8 as a negative number by noticing the minus sign in '-8,' but he must also learn that he is wrong if he uses the same "clue" for deciding that $-y$ is a negative number.

More illustrations could be given of the confusion that exists in conventional treatments concerning letters in mathematical expressions. The above should suffice to exemplify the fact that such confusion in the text will necessarily confuse the student.

In UICSM courses, since the distinction between number and numeral is made at the outset, the problem of explaining the use of letters in mathematical expressions is comparatively easy. First, the students consider sentences made up of numerals connected by an '=,' for example:

$$3+2=4+1, \qquad 8-3=\frac{10}{2}, \qquad \text{and} \qquad 7+4=8+2.$$

They learn that such sentences are true if the numerals connected by the '=' are names for the same number, and that such sentences are false if the two numerals are names for different numbers. Next, the students are given sentences to be completed [such as '——— $+3=8$' and '□ $-5=11$'] into true sentences by writing a numeral in the blank space. They are also asked to convert such sentences into false ones by again writing a numeral in the blank space. After a little practice, the students quickly perceive the difference between, for example:

$$\square - 5 = 11, \text{ and } 7+4=8+2 \text{ or } 3+2=5.$$

In the second and third cases they have sentences which are either true or false, but in the first case they have a sentence which is *neither* true nor false.

The student compares sentences in English which contain pronouns such as 'he' or 'she' with mathematical sentences which contain frames or blanks. They soon decide that just as a pronoun in an English sentence holds a place for a name of a person or thing, so a blank or a '□' in a mathematical sentence holds a place for a name [numeral] for a number. It seems sensible, then, to call a mark such as '———', '□' or 'x' a *pronumeral*. And, with this development, the important idea is established: that pronumerals do not stand for numbers, nor are they numbers; they are marks which stand in place of numerals. [In conventional courses, the words 'general number' or 'literal number' are often used instead of 'pronumeral'. The technically correct term is 'numerical variable.']

With this development of the notion of a pronumeral as a placeholder for a numeral, it is easy to prepare students for the important task of stating generalizations about numbers. When he sees a sentence such as '$5 \cdot a = a \cdot 5$,' he knows immediately that each conversion of this sentence is true because upon replacement of each 'a' by copies of the same numeral, the resulting sentence is an instance of the commutative principle for multiplication. [The student is aware of the commutative principle for multiplication, as well as other properties of addition and multiplication, and has learned the word 'commutative' before he learns of pronumerals.] The student may say that the sentence '$5 \cdot a = a \cdot 5$' is true for all numbers, meaning, of course, that when 5 is multiplied by any number, the same product is obtained as when that number is multiplied by 5. Similarly, he will aver that the sentence '$a \times b = b \times a$' is true for all numbers, meaning that when a first number is multiplied by a second number, the same product is obtained as when the second number is

multiplied by the first number. He learns that he can say this in a much shorter way by using, along with the sentence 'a $\times$ b = b $\times$ a', *quantifier* phrases such as the prepositional phrases in: For each number a, for each number b, a $\times$ b = b $\times$ a. This displayed sentence is the commutative principle for multiplication. The student regards it not as a statement about the letters 'a' and 'b' but as a statement about multiplication of numbers. He gets instances of it by taking the sentence which follows the second comma, selecting a number from the set of *all numbers*, writing a name for it in place of each occurrence of 'a,' and repeating this procedure for 'b.' Thus, an instance is: $6 \times -2 = -2 \times 6$.

Using precise language to state a generalization which he has discovered becomes a relatively simple matter for a student in UICSM courses. An incident that occurred in a class in one of the pilot schools of the UICSM Project will serve to illustrate this fact. A student had difficulty determining the root of the equation '13x = 9'; after some experimentation, he discovered that $\frac{9}{13}$ was the number required. Then the teacher asked for roots of the following equations:

$$15x = 7, \qquad 8n = 3, \qquad 0x = 5,$$
$$19a = 17, \qquad 15x = 30, \qquad 157b = 113.$$

When the students began to determine very quickly the roots of equations such as the last ones, the teacher knew that the students were aware of the desired generalization, and asked for a statement of the principle being used. Now, to do so using ordinary English is a bit complicated, but one might say: "The number which you multiply a first number other than zero by in order to get a third number, is the quotient of the third number by the first number." But, few ninth-grade pupils can use English in such a precise way. However, there were many students in this class who were able to offer the following statement: For all numbers a (except 0) and b, $a \times \frac{b}{a} = b$.

The above incident is typical of the kind of work encouraged in UICSM courses. As the student discovers generalizations he feels that he is playing an important part in developing mathematical ideas and procedures. And, as he uses precise language to state these generalizations, his understanding of them is augmented. For these reasons the text is designed in such a way that both exposition and exercises lead students to *discover* principles and rules.

Encouraging Generalizations

The earliest opportunity for an important discovery in the UICSM program presents itself in connection with the methods for operating with real numbers [these are sometimes called 'directed numbers']. Students are not given rules for such operations, but instead, they are given several reasonable interpretations of the symbols for positive and negative num-

bers. The students then construct rules for operating with such numbers, in accordance with these interpretations, as well as effective and quick ways of carrying out the rules. Both text and teacher avoid asking for a statement of the rules at this early stage of the student's learning, since the student is not linguistically prepared to formulate such a statement. This is especially true when the student does not yet know how to use variables. An imprecise verbalization is not a faithful rendering of what the student really believes, and the technical errors in it are difficult to correct at this early stage. [It should be mentioned here that the incident reported earlier in this article, in which the students were asked to verbalize the generalization as soon as their awareness of it was evident, occurred during the second semester after much practice in discovering generalizations.]

Another topic in which UICSM courses insist on discovery is that of solving simple equations and inequations. When a student understands what an equation is, and what it *means* to solve one, he can invent his own methods for solving many of them. Equations and inequations such as:

$$r + 5 = 11, \qquad 7a = 21, \qquad x - 3 < 10,$$

$$\frac{3n + 2}{4} = 5, \quad \text{and} \quad |x + 4| > 6,$$

are solved with considerable speed by ninth-grade pupils in UICSM classes, even though no formal rules for finding the solutions have been given. When some of the teachers in UICSM pilot schools first read about this technique for teaching equation solving, they were quite dubious as to its probable effectiveness. However, a first trial with the class convinced them of its worth. The students become intrigued by the problem of converting sentences like those given above into true ones, and their interest is sustained by making them rely completely on their own ingenuity. That they *can* discover workable techniques for solving problems of this nature is all the evidence needed to convince them that mathematics is a human endeavor which requires creative energy and carries its own reward.

Furthermore, students who have this experience of discovering their own methods for working out various kinds of mathematical problems are much better equipped to figure out solutions to new problems. Thus, power in mathematical thinking, and a developing interest in mathematics, are two very desirable outcomes of the use of the discovery method.

Continual Revision of Courses

As mentioned earlier in this article, the UICSM courses are subject to continual revision, information on which to base these revisions is obtained by means of close communication with the teachers and classes in the pilot schools. The detailed reports of the teacher coordinators who visit

the pilot schools, a testing program, regional training conferences, and the weekly written reports from participating teachers, all are of strategic value in determining revisions.

However, a certain amount of stability in content of UICSM courses is now evident, even though the final syllabi have not been made. Hence, a brief outline of the major topics included in the courses may be given.

First Course

Distinction between numbers and numerals.
Real numbers.
Principles of real numbers (associativity, commutativity, *etc.*).
Inverse operations.
Relations of inequality.
Numerical variables ("pronumerals").
Generalizations about real numbers.
Notation and some concepts of the algebra of sets.
Solution of equations, linear and quadratic.
Solution of "worded" problems.
Ordered pairs of numbers.
Graphing equations and inequations.

Second Course

Sets and relations.
Linear and quadratic functions.
Systems of linear equations.
Measures of intervals, arcs, angles and plane regions.
Elementary properties of angles, polygons, and circles.
Further study of manipulations of algebraic expressions.

Third Course

Mathematical induction [generalizations, hereditary properties, recursive definitions, progressions, Σ-notation].
Exponents and logarithms [continuity and the limit concept, geometric progressions, the binomial series].
Complex numbers [field properties, systems of quadratic equations].
Polynomial functions [the factor theorem, synthetic division, curve tracing].

Fourth Course

Circular functions [winding functions, periodicity, evenness and oddness, monotoneity, "analytical trigonometry" rather than "triangle-solving," inverse circular functions].
Deductive theories [abstraction of postulates from a model, deduction of theorems from these postulates without reference to a model, re-interpretation of the theory to yield information about other models].

Proposals of the Commission on Mathematics of the College Entrance Examination Board

ALBERT E. MEDER, JR.

THE Commission on Mathematics of the College Entrance Examination Board, appointed in 1955, grew out of the concern of the mathematics examiners that the Board's tests were not reflecting fully and appropriately the emerging programs of mathematics instruction in forward-looking college preparatory schools, both public and private, and, moreover, that the standard curriculum taught in most secondary schools was sadly out of date. The Commission was formed to consider broadly the secondary-school college preparatory curriculum and to make recommendations looking towards its modernization, modification, and improvement. It seeks to secure the introduction in American secondary schools generally of a mathematics program oriented to the needs of the second half of the twentieth century. These needs are vastly more extensive than was the case when the present traditional curriculum took form. Moreover, mathematics itself has changed both in content and, more important, in the point of view from which it is regarded by mathematicians.

The traditional secondary-school program in mathematics, made up of elementary algebra, plane geometry, intermediate algebra, solid geometry, trigonometry, and advanced algebra, consists almost entirely of mathematics developed over 300 years ago, gradually introduced into the schools over the past 150 years and crystallized into essentially its present form approximately 60 years ago. The subject matter was chosen and the presentation organized in accordance with an attitude toward mathematics that is now antiquated and has been discarded by present-day working mathematicians. The curriculum contains much obsolete material and, instead of being oriented to the needs of the second half of the twentieth century, it is designed to meet the needs of science and technology as these needs existed some 75 years ago. It constitutes a very slow, inefficient introduction to modern mathematics. In a publication issued early in its existence, the Commission pointed out six specific areas in the present curriculum which need revision:

1. Too much attention is given, particularly in algebra, to routine manipulation in artificial situations, and not enough emphasis is laid on fundamental concepts.
2. Deductive reasoning is taught chiefly in connection with plane and solid geometry, and its application to other parts of mathematics is largely ignored. Its use in algebra and trigonometry should be expanded.
3. Too often, the usual geometry course consists of rote memorization of sequences of theorems and fails to explain the deductive process clearly.

Albert E. Meder, Jr., is Dean of Administration, Rutgers University, New Brunswick, New Jersey.

4. Many topics which are now included were important at one time for applied science, but now have become obsolete. These should be replaced by topics of current importance. Examples of obsolete topics are: extensive solution of triangles by logarithms, deductive methods in solid geometry, and Horner's Method for finding the roots of a polynomial.

5. Examples of modern subjects which might be included are: descriptive statistics, statistical inference, elementary properties of sets, and the basic ideas of modern algebra. Many of these topics are more elementary than topics now in our curriculum.

6. Mathematics is too often presented as a series of isolated tricks so that students get no view of the subject as a whole, and do not realize its position as a creative endeavor in our civilization.

This last point is of the utmost importance. Too frequently students have the point of view toward mathematics described in the following comment made by a university professor concerning a class of able freshmen. "I had great difficulty," he said, "not in teaching them the subject itself, but in getting them to see what it was all about. Their concept of mathematics seemed to be that mathematics consists of a collection of tricks, from which the student must select, without any rational basis for doing so, the right one to produce the answer given in the back of the book."

Rather than this attitude, students should be led to study mathematics in terms of structure and pattern rather than in terms of rules and tricks. Such an attitude will be greatly facilitated by a curriculum organized from this modern point of view; indeed, such reorganization is probably absolutely essential.

Mathematics is a different subject today than it was a generation ago, its applications are vastly more extensive, and its essential nature is now considered to be entirely different than was the case heretofore. Thus to meet the manifold social needs of the second half of the twentieth century —the needs of mathematics itself, of physical science, of social science, of technology, of industry—requires a curriculum revised in content, but even more basically revised in point of view. The most important point to be made with respect to the actual details of revision is that any proposals should be based on a careful analysis of the curricular implications of such matters as were set forth in the preceding section, and should not consist of more or less drastic changes hastily improvised because of the sudden clamor for improvements in science and mathematics teaching that followed the launching of the Russian Sputniks.

Such ill-considered proposals as requiring all high-school students to take more mathematics, without regard to the suitability of the course content to the needs of the student; introducing courses in calculus without regard to the adequate preparation for this work of either pupils or teachers; placing additional emphasis on manipulative drill without corresponding emphasis upon understanding; increasing the time for the development of computational skill in trigonometry or advanced algebra—these can all do more harm than good. They accomplish little in the

short run, and seriously handicap the progress of necessary changes in the long run.

The Commission on Mathematics is convinced that curricular revision will be successful in producing a high-school mathematics curriculum oriented to the needs of the present and the future only if three principles are heeded.

1. The proposals must be based on the existing curriculum, and must consist of modification, modernization, and improvement of the present pattern, rather than its discontinuance and replacement by entirely new content.

2. The point of view of modern mathematics must be used as a guide in determining the modifications to be made. This point of view is well stated by W. W. Sawyer, who wrote: "The mathematician of older times asked, 'Can I find a trick to solve this problem?' If he could not find a trick today, he looked for one tomorrow. But today we no longer assume that a trick need exist at all. We ask rather, 'Is there any reason to suppose that this problem can be solved with the means we have at hand? Can it be broken up into simpler problems? What is it that makes a problem soluble, and how can we test for solubility?' We try to discover the nature of the problem we are dealing with."

This concern with the nature of a problem, with what Sawyer elsewhere calls "pattern," is characteristic of present-day mathematics, and is the point of view that should be inculcated in students. Indeed, mathematics may very properly be regarded as the study and classification of all possible patterns. This conception, wherein we mean by pattern any kind of regularity that the human mind can recognize, gives unity to the many diverse topics included in the field of mathematics, and what is even more important, enables teacher and student to approach the study of mathematics creatively. Nothing less can truly meet the needs of the present day.

3. Changes to be proposed must be sufficiently far reaching so that the modified curriculum is truly oriented to present the future needs, but not so radical as to be beyond the competence of the available teaching staff. However, a willingness upon the part of school officials to provide means for teachers to participate in programs of in-service education must be assumed.

Moreover, in making its recommendations the Commission, while having in mind the college preparatory group, has not formulated proposals intended exclusively for gifted pupils, so-called, or for those looking forward to professional work in mathematics or science. The Commission is keenly aware of the place of mathematics in general education; in its judgment one of the defects of the present traditional college preparatory curriculum is that it does not pay nearly enough attention to mathematics as general or liberal education. Indeed, many topics now included have no significance except that at some future date some stu-

dents proceeding to more advanced study would find a knowledge of these items useful (assuming, of course, that by that time they had not completely forgotten them).

The Commission has, therefore, consciously attempted to formulate a program that in itself constitutes an appropriate part of liberal or general education. It is of course also preparation for later work, but in the broad sense that students who have studied the recommended curriculum should have developed such maturity, power, and understanding as to be ready for mathematics on a true college level.

Indeed, so important does the Commission believe the general education aspect of its program to be that it will recommend in its report that all college-bound students, whether anticipating further work in mathematics or science or not, should include the first three years of the Commission's proposed curriculum in their high-school schedule. Only in the fourth year—advanced mathematics in the Commission's nomenclature—is it assumed that students taking the course are anticipating further college work in mathematics or science.

And, finally, in no case is it assumed that students in this program are "gifted" or exceptionally talented in mathematics. The Commission's proposals constitute recommendations for the revision of the high-school curriculum to be followed by the average, normal, or ordinary college-bound student; indeed, as an optimum by all such students for three years.

The specific changes suggested by the Commission are set forth in detail in its report, published recently. They are accompanied by both exposition and supporting argument. Here they can only be summarized, as follows:

Algebra

Little change in the actual content of elementary and intermediate algebra is envisaged, but a fundamentally altered point of view is regarded as absolutely essential. Algebra must be treated as a study of mathematical structure, rather than only as the development of manipulative skill in one particular mathematical system. The study of inequalities as well as equations, and of expressions involving the concept of absolute value should be added to the syllabus. Provision should be made for experience in deductive reasoning in algebra as well as in geometry.

The introduction of the point of view advocated by the Commission will require that teachers familiarize themselves with certain concepts not hitherto ordinarily included in their college training, in particular the notions of set statements, variable relations, and functions, as these are formulated in modern mathematics.

Geometry

The Commission assumes that the mathematics of the seventh and eighth grades will include a substantial intuitive, informal, and non-deductive introduction to geometric figures, concepts, and measurement. On this foundation high-school geometry should build a sound under-

standing of the nature of deductive reasoning, a more adequate knowledge of geometric facts, and an experience in mathematical creativity on a level appropriate for each student. It is one of the unusual advantages of the subject matter of Euclidean geometry that it may include exercises sufficiently easy for almost any student to have the experience of discovering something for himself, but also problems sufficiently complex to challenge the brightest minds.

These objectives just suggested are not usually attained in existing courses; the difficulty is to be found in the distressingly long list of theorems to be proved, in the exclusive use of synthetic methods, and in the rigidly formalized proofs usually required. Meaningless memorization by rote is often substituted by less able students for any attempt to creative understanding.

The Commission accordingly proposes a greatly curtailed list of required theorems, the introduction of algebraic methods, and the exploitation of every opportunity—and they are numerous—to develop spatial concepts in addition to the concepts of plane geometry. It is a strange inconsistency that graphing is commonplace in algebra, but the same basic idea of correspondence between points and numbers is not carried over in the employment of algebraic methods in geometry. These are often much easier and much more rapid than the purely geometric methods exclusively utilized hitherto.

With these changes, one year is regarded as sufficient for the geometry course, and the Commission recommends the elimination of solid geometry as a separate semester course.

Trigonometry

Traditionally the emphasis in trigonometry has been on the computational aspects of the subject, particularly the solution of triangles. This is an excellent example of obsolete material. Today's practical problems of trigonometry involve vectors and their components rather than the solution of triangles; modern means of computation utilize calculating machines rather than logarithms. The "trigonometry of angles" presently emphasized can be reduced to a much smaller compass than is now devoted to it.

The Commission recommends that the present semester course in trigonometry be split into three parts: certain topics to be completely discarded; certain topics to be included in the second-year algebra course (the "trigonometry of angles" and such computational aspects of the subject as are retained); and a third part, "analytic trigonometry," to constitute part of the fourth-year program.

The first three years of secondary-school college preparatory mathematics will thus include the essential topics in algebra and geometry (for the "trigonometry of angles" is really a part of Euclidean geometry) on which a truly modern college freshman course can be built. Several promising and interesting possibilities for suitable courses are open to

college departments of mathematics; the traditional freshman year of trigonometry and "college" algebra is not one of them, however. Such a program would be distinctly inappropriate; elementary analysis or an introduction to modern mathematical concepts should form the core of the course.

For the twelfth grade the Commission offers three options. It believes that one area is absolutely essential: a course in Elementary Functions should be included no matter what other topics are chosen for the twelfth-grade syllabus. This course, which should include a study of polynomials, exponential and logarithmic functions, and the circular (trigonometric) functions and their inverses should cover one semester at least. By the addition of other selected topics, it could be extended to a full year. Many schools will wish to do this, and, for their benefit, the Commission report includes specific suggestions as to content.

The preference of the Commission, however, is somewhat different. It would prefer to have the second semester devoted to a course in probability and its applications to statistical inference. It is truly one of the most significant advances in the mathematical research of the past 30 years that mathematics can now be applied to phenomena in which chance plays a role. It is this advance that has made possible many of the applications of mathematics to social science. Thus, statistical inference has now become a form of mathematical thinking second only in importance to deductive reasoning. As we teach the latter, so we should also teach the former.

Moreover, statistical inference is a form of reasoning of basic significance in the everyday life of twentieth century Western civilization. Public opinion polls, radio and television ratings, even scholastic aptitude test scores are inferences drawn from information about a mere sample of the population concerning which the conclusion is stated. Both because of its practical and its theoretical importance, the Commission recommends the inclusion of probability and statistical inference in the high-school curriculum.

This is a subject that most teachers have never studied, at least in its mathematical aspects. Those who are called upon to teach the senior course will wish to make adequate preparation, either by self-study or course work.

The twelfth-year course might thus consist of "Elementary Functions and Selected Topics," or of "Elementary Functions" and "Introductory Probability and Statistical Inference"; a third option is "Elementary Functions" and "Introduction to Abstract Algebra," a semester course dealing with such modern algebraic concepts as groups and fields.

Calculus

The Commission does not recommend the inclusion of a course in calculus as a part of the normal high-school curriculum. The average student cannot be adequately prepared for such a course in three years,

and anything less than a full-year course will ordinarily be time wasted, since it will not fit into any typical college program. Moreover, a course in calculus deals with ideas that are mathematically quite sophisticated, and mathematical maturity is absolutely essential. There is no value whatever in a course in calculus that merely sets forth rules for calculation and formulas for solving certain types of problems without adequate attention to conceptual difficulties.

Secondary schools should teach calculus only to able students who have found it possible to complete a full four-year high-school program in three years, and then should be sure that it is taught on a college level with college standards. In such cases, advanced placement or credit may appropriately be sought.

The curriculum envisaged by the Commission fulfils the three conditions laid down above. Moreover, it permits a student entering college with either three or four years of high-school mathematics to take a genuine college course in his freshman year. No longer will it be necessary for colleges to give essentially high-school work, and rather uninspiring high-school work at that, to their freshmen, as has typically been the case in many institutions. Students offering four years of high-school mathematics will be fully prepared to take a standard college course in calculus and analytic geometry; those offering three years will take a less exacting course, but one on a true college level.

Moreover, the curriculum proposed by the Commission is genuine secondary-school mathematics; it is in no sense an attempt to have secondary schools teach collegiate or higher mathematics. Nor is the new curriculum made up of a selection of topics chosen because they are needed in more advanced work. The curriculum prepares for more advanced work, but only by the appropriate means of seeking to develop sufficient mathematical understanding, power, and maturity through the study of pertinent secondary-school mathematics that the graduate will be ready to advance to the study of collegiate mathematics.

Finally, although the program has been developed for college preparatory students (it would be impertinent for the College Entrance Examination Board to make suggestions for non-college bound students), many of the Commission's proposals—with the "voltage" lowered, so to speak—are also appropriate for the so-called "general" mathematics courses. Particularly is this true of the Commission's strong emphasis on point of view as even more important than content. For creative teaching and a curriculum that permits and encourages it is of the utmost importance no matter what the ability or objective of the pupil. While of course mathematics is a tool in the sense that it may be utilized in solving problems arising outside the subject itself, and while it has also been properly called "the language of science," neither of these descriptions is adequate. Far more than "tool" or "language," mathematics is a way of thinking, a far-reaching method of thought. Only a philosophy of educa-

tion that so regards it can constitute a valid basis for meeting present-day needs.

Finally, the following summary of the Commission's thinking will appropriately summarize what has been said.

For College-Capable Students, the Commission on Mathematics Presents a Nine-Point Program To Meet Contemporary Needs

1. *Strong preparation, both in concepts and in skills, for college mathematics at the level of calculus and analytic geometry*
2. *Understanding of the nature and role of deductive reasoning—in algebra, as well as in geometry*
3. *Appreciation of mathematical structure ("patterns")*— for example, properties of natural, rational, real, and complex numbers
4. *Judicious use of unifying ideas*—sets, functions, and relations
5. *Treatment of inequalities along with equations*
6. *Introduction of coordinates and vectors in plane geometry and in trigonometry*
7. *Space perception and essentials of solid geometry incorporated with plane geometry*
8. *Twelfth-grade mathematics centered on elementary functions*—polynomial, exponential, circular
9. *Additional twelfth-grade material recommended: either introductory probability and statistical reasoning, or an introduction to modern algebra* (fields and groups)

The School Mathematics Study Group

E. G. BEGLE

THE world of today demands more mathematical knowledge than the world of yesterday, and the world of tomorrow will demand even more.

The uses of classical mathematics—calculus, differential equations, complex variable theory, *etc.*—in science and industry are so well known as to need no discussion here. Not so well known perhaps is the fact that science and industry are finding uses for other kinds of mathematics, topics which until recently seemed to have few or no applications at all. Also, many areas of business, such as accounting, data processing, and decision making by administrators, make increasing use of mathematics, quite often the newer mathematics. The same is true of the social sciences, economics in particular, but also psychology and even anthropology. The

E. G. Begle is Executive Director of the School Mathematics Study Group, Yale University, New Haven, Connecticut.

widespread and rapidly increasing use of electronic computing machines has created a great demand for persons with mathematical training.

This explosive growth in the use of mathematics demands a new kind of training. A hundred years ago one could safely predict that the world would not change very much in the next twenty years. Therefore, it was reasonable to teach in the schools those skills which were currently useful, since they would still be useful after the student left school and entered his chosen occupation. Fifty years ago this was still true. Twenty years ago it was true to the extent that skills taught then are useful today. However, we can look around us and see that we now need not only the old skills but also many new ones which were unknown twenty years ago.

In addition, our rate of progress is now increasing so rapidly that we find it impossible to predict which skills will be the important ones in even the near future. Therefore, we must teach our students in such a way that they will develop not only skills but also an understanding of mathematics sufficient to allow them to acquire new skills as they become important in the future.

The present secondary-school curriculum in mathematics is not satisfactory when viewed against these requirements. A widespread awareness of the shortcomings in the content and organization of courses presently taught has caused several professional organizations to concern themselves with this problem and to join the effort to improve the teaching of mathematics in the schools.

The National Council of Teachers of Mathematics, the Mathematical Association of America, and the American Mathematical Society cooperated in organizing the School Mathematics Study Group and in seeking the necessary funds for its operation, which funds were furnished by the National Science Foundation.

The School Mathematics Study Group is composed of individuals representing all segments of the mathematical profession, and includes high-school teachers, college and university mathematicians, school administrators, and representatives of science and industry. As a national organization, its membership is drawn from all parts of the country.

The fundamental aim of the SMSG is to improve the teaching of mathematics in the secondary school, to persuade more students to study more mathematics, and to ensure that the mathematics they study is appropriate to the world of today. One of the basic objectives, therefore, of the SMSG is an improvement of the mathematics curriculum. In considering this problem, the Group will keep the following points in mind:

1. No one can predict exactly what mathematical skills will be important and useful in the future.

2. No one can predict exactly what career any particular student will choose when he leaves school.

3. Teaching which emphasizes understanding, insight, and imagination, without neglecting basic skills, is the best for all students of whatever ability and makes the best preparation for any vocation which uses mathematics.

4. An understanding of the role of mathematics in our society is essential for intelligent citizenship.

5. Any normal individual can appreciate some, at least, of the beauty and power of mathematics, and this appreciation is an important part of a civilized person's cultural background.

The SMSG also is convinced that no single curriculum is to be preferred to the exclusion of all others. In view of varying circumstances and changing needs, the current spirit of experimentation is essential. The SMSG intends to concern itself with students in all parts of the country and at all levels of ability.

Improvement of the curriculum will be a long-term process and will proceed in a number of steps. A massive effort to revise the curriculum radically, in the hope that the result would prove satisfactory for a long period, would be doomed to failure for many reasons. The problem of training teachers for such a radically new curriculum would be enough to rule out such an effort. But there are other reasons. There has been enough study of the program for grades 9 through 12, for example by the Commission on Mathematics and the University of Illinois Committee on School Mathematics, among others, so that the direction of improvement in the curriculum for these grades is clear. Action here can be started at once. But it is not so clear what ought to be done in grades 7 and 8, so study and experimentation are necessary. But any new curriculum for these grades which might result from this study and experimentation will probably necessitate further revisions in the curriculum for the higher grades.

The teaching of mathematics in the elementary grades ought to be studied carefully, and the very best psychologists and social scientists ought to be drawn into this study. The order of presentation of topics, and kind of subject matter now taught in the elementary schools ought to be examined most carefully. The results of such a study, which would necessarily take many years, could have a profound effect on the elementary-school curriculum and hence a profound effect on the secondary-school curriculum.

The SMSG, therefore, believes that its proper function in the area of curriculum improvement is to join in the effort to get an evolutionary, not revolutionary, program into motion. If a good start can be made, such a program can very likely continue pretty much under its own steam, but such a start demands vigorous and large scale effort.

For the present, the SMSG is confining its attention to grades 7 through 12. It has under way at present two specific projects concerned with the curriculum. The first of these is concerned with grades 7 and 8.

The School Mathematics Study Group feels that it is particularly important that greater substance and interest be given to the mathematics of these grades. The usual curriculum for these grades, it is felt, is boring to the good student and frustrating to the weak one. The usual subject matter in these grades is poor preparation for later courses.

The SMSG is, therefore, undertaking an experimental program in which a variety of short units, chosen for their mathematical value, their interest to students, and their importance in general education, have been written and are being tried out in a large number of classes during the academic year 1958-59. From those which prove to be both valuable and teachable, a new curriculum will be constructed, at a conference to be held in the summer of 1959, and will be carefully tested and evaluated during the following school year.

Some of these units were produced at a writing session held at Yale University in the summer of 1958. The titles of a few of these may give some indication of the kind of subject matter to be included, though of course they can give no indication of the spirit in which they are written: Why Study Mathematics?; Decimal and Non-Decimal Numeration; Factoring and Primes; Non-Metric Geometry; Angle Relationships; Approximation; Mathematics in Science—The Lever; Chance.

The SMSG, in this program, works in close cooperation with the University of Maryland, where a similar program was started in the fall of 1957. In particular, some of the material produced at the University of Maryland is being used by the SMSG in a variety of locations outside the Washington, D. C., area.

The second project now under way is concerned with grades 9 through 12 and is directed toward the production of sample textbooks for these grades. These texts will illustrate the kind of changes in the curriculum which the SMSG thinks desirable and necessary.

There are many high-school teachers who are eager to teach improved courses and who have gone to some trouble to prepare themselves for such a change; for example, by attendance at Summer or In-Service Institutes sponsored by the National Science Foundation and others. The great majority of these teachers, however, find it difficult to see just how they can bring into their classrooms the new mathematics, or the new way of looking at mathematics, which they have learned. The chief use, then, of these sample textbooks will be to offer concrete illustrations of how this can be done.

In addition, since both experienced teachers and able research mathematicians are collaborating in the writing of these texts, the final result should provide a useful source of suggestions and set high standards for the individual authors who will write the classroom texts of the future.

A start on these texts was made at the Yale writing session. Detailed outlines for each of the grades 9 through 12 were prepared and a few chapters were written in full. Work is continuing, on a reduced scale, during the academic year 1958-59, and it is hoped that first drafts of the complete texts will be completed during a second writing session in the summer of 1959.

A third project which has already started is not concerned with the curriculum. In order to arouse and keep the interest of better students, to broaden the mathematical background of teachers, and to present to the

educated lay public a better picture of the place and importance of mathematics in our culture, the School Mathematics Study Group will produce a series of monographs on various topics. For the most part, these topics will be ones which are not ordinarily included in the standard high-school course. Outstanding mathematicians will be invited to write these monographs, and every effort will be made to see that the level at which they are written is appropriate to the audience at which they are aimed. A few of the topics which are under consideration for these monographs are: Non-Euclidean Geometry; Topology; Computing Machines; Primes; Cryptography; Logic.

A fourth project on which a start has been made is designed to assist teachers directly. Many teachers would like to improve their mathematical training by study, either individually or in small groups. This is, however, not always easy to do since the books which are available to them often contain much more than is really needed or perhaps omit topics which are essential for the teacher. The SMSG has, therefore, prepared a study guide for teachers. This consists of a list of books, which was kept as short as possible for the sake of the teacher's pocketbook, and a chapter by chapter commentary on each book to indicate which topics in each chapter should be studied carefully, which can be slighted, and which can be omitted entirely.

In addition, some material prepared at the Yale writing session is in a form which would provide interesting and useful background information for teachers. This is being made available as rapidly as possible. In addition to the four areas listed above in which the SMSG is now working, there is a number of other areas which at the moment are under study.

The curriculum illustrated in the sample textbooks which are in preparation is designed for students in the top half of the class. It seemed proper to the SMSG to consider this group first, since it is from this group that our future scientists and engineers, as well as our leaders in all the professions, will come for the most part. Nevertheless, the SMSG has no intention of neglecting the slower students. Quite often, at present, such students are shunted off to a course which deprives them forever from an opportunity to take further courses in mathematics. We feel that this is deplorable, and that all students should have an opportunity to take as much good mathematics as they are capable of learning. In theory, the course designed for the faster students should, if made perhaps more intuitive and taken at a slower pace, be attractive and valuable for slower students. Whether practice will accord with theory is a question which the SMSG will study very carefully. Such a study must await the completion of our sample texts, but it should be possible to make a start on this next year.

Another area in which study is under way is that of the use of films and TV in teaching and in teacher training. The problems here are very

thorny ones, and financial considerations are substantial. The SMSG, therefore, will devote a great deal of study to these problems and enter into some careful experimentation before plunging into any large-scale production of films. Other problems which are under study by the SMSG include that of providing material for the gifted student, of attracting competent research psychologists into a study of attitudes towards mathematics, and of stimulating the production of better texts and better courses for teacher training institutions. Finally, the SMSG is about to come to grips with the fact that each child who enters the seventh grade has gone through the first six grades. What, if anything, should this Group do about the mathematics of these grades?

The SMSG thus faces an enormous task. It will have to enlist the aid of many individuals. It cannot expect to finish its job quickly. But the Group is optimistic that real progress can be made. Much of the reason for this optimism comes from the success of the writing session at Yale University in the summer of 1958. At this session was gathered a rather heterogeneous collection of classroom teachers and university mathematicians. The speed with which communication was established and understanding of each other's problems was reached was remarkable. The spirit of mutual understanding, cooperation, and enthusiasm which developed promises well for the future.

Chapter II

Mathematics for a Liberal Education

Mathematics in General Education

HAROLD P. FAWCETT

DURING the first half of the present century, the problem of general education has received increasing attention and, within the last twenty-five years, there has been a steady and continuing effort to plan programs of study designed to raise the educational level of all our students in both secondary schools and colleges. Along with this increasing emphasis on general education, there has been a tremendous increase in knowledge which has led to even greater demands for specialization and we are now faced with the problem of providing a satisfying program of general education while at the same time we cannot neglect the ever increasing call for specialists.

The distinction between general and special education is fundamentally one of purpose and not of content. To guide a student in such a manner that he becomes critically sensitive to the methods he is using and to the assumptions which give direction to his study leads him to transcend his specialty and makes a large contribution to his general education. The process of education is a process that is continuous and indivisible. There is, in fact, no sharp dichotomy between the general and the special. These two emphases are but aspects of the long educational continuum. They do not differ in kind, but only in degree. They are connected and, in the slightly modified words of the Harvard Report, the special forever flows out of the general and forever returns to enrich it.

Against this background let us now consider the role of mathematics in a program dedicated to the purposes of general education. There are many who believe that mathematics has no place in such a program, but they fail to recognize that the language of mathematics permeates the fabric of our society, and to be ignorant of its signs and symbols, its processes, and its methods is to be unable to read with insight and understanding the publications which come to our homes. The world in which we live is incurably mathematical and modern culture in large measure derives its substances and its texture from the science of mathematics. The call for mathematics, for scientists and for engineers is today louder than at any time in history, but we cannot find them in a culture which

Harold P. Fawcett is Professor of Mathematics Education, School of Education, The Ohio State University, Columbus, Ohio.

has been following curricular practices destined in the long run to produce a generation of mathematical illiterates. The development of a mathematician, a scientist, or an engineer does not begin in the university. The manpower problems of this country will never be satisfactorily solved until, in our general education program, we develop a genuine appreciation for the language of mathematics and an abiding respect for the very important work of the mathematician. He needs the support of Mr. T. C. Mits, The Celebrated Man in the Street, for the strength of a culture depends in large measure on the extent to which its citizens understand and support the work of the experts.

We have, in my judgment, tended to neglect the important contribution which mathematics can make to the general education of our citizens and it was undoubtedly evidence of that very neglect which many years ago stimulated the distinguished mathematician, Professor Eric Bell, past president of the Mathematical Association of America, to make the following prophetic statement:

> The arresting thought that we, as mathematicians, have done next to nothing to inform and convince the sweating man and the sweated woman, whose hard labor makes possible our pursuit of the "science divine," that mathematics does mean something in their lives and might mean more, may well make us apprehensive of the future, for these too patient men and women in the storm ahead of us all will cast the deciding vote.

How convincingly has time vindicated his judgment! In our classes today are young people who tomorrow will be serving on boards of education, who will be officers of Parent-Teacher's Association, counselors of young people, or even superintendents of schools who, if they are to "cast the deciding vote," should indeed understand the nature of the important contribution which mathematics does make to their lives.

Now, mathematics is not a set of isolated and unrelated topics. It is a system of ideas unified by such fundamental concepts as number, measurement, relationship, operation, symbolism, and proof which relate it to other fields of learning and which grow in meaning and significance for the student as his study continues. To nourish the growth of these concepts, to develop their relation to the problem-solving process and to open inviting channels of investigation and study will stir the imagination of the students, will provide the academic and vocational flexibility so essential in guiding their educational choices, and will also suggest how "the special flows out of the general and forever returns to enrich it."

What, for example, is 2. Is it a name given to the cardinal number of a group or is it a position on the number scale? Perhaps it is the value of "a" in the rational number "a/b" or it could be the value of the repeating decimal 1.999999999.... and on to infinity. On the other hand it might be a short way of writing the complex number $2+0i$ and if one is asked to answer the apparently simple question "What is 2?" the nature of his response will depend on how far his vision extends down the long con-

tinuum of the growing concept of number. The answer of Lawrence A. Ringenberg in his delightful little pamphlet entitled "A Portrait of 2" is the answer of a man who fully understands the role of number in the general education of our citizens as well as its tremendous significance to the specialists. The extension of the number concept from its primitive beginnings, rooted in the distant past, to include fractions, signed numbers, rationals, irrationals and on through complex, transcendental, and transfinite numbers is indeed a tribute to the spirit of man. It has been well said that "The perfected number system is, in many respects, the greatest achievement of the human race."

There are two faces to mathematics—that which looks to the external world of outer reality lying in time and space and that which looks to the inner realm of order and consistency among propositions and principles. Measurement is the instrument of the first, while implication and proof are the hall marks of the second. In the long history of man's continued effort to control his environment, there has never been a period when he was not struggling with the problems of measurement. The origin of this important concept is hidden behind the impenetrable veil of the past. It is like a ladder up which civilization has gone in an effort to answer the call of the human spirit, a ladder whose base is anchored in the mists of antiquity and whose topmost rung has never yet been reached. In fact, it never will be, for, as man moves upward in his continuing search for truth, new rungs will be recognized along this intriguing way which invites the spirit of man to move steadily forward and to push still further into the unexplored mists of the future. From the crude standards of primitive times, based on the human body as a primary source of reference, through the selection of an arc of a meridian to the present use of the cosmic unit, man reflects his continuing search for an absolute standard. It is still true, however, that all measured values are approximate and, to deal intelligently with data secured through measurement, man must understand the significance of such ideas as precision, accuracy, significant figures, rounding off, apparent error, and relative error. In fact, he must understand what it means to think statistically, for today the language of elementary statistics is the language of the educated layman.

If there is any one fact that commands the respect of thoughtful people everywhere, it is the tremendous fact of change. But elements which constitute the great continuum of life are related and the study of relations is one of the major concerns of mathematics which has, in fact, been defined as the science of necessary relations. To think at all is to think in terms of relations and, from the simple number relations of the early grades to the functional relations of the calculus, the mathematics teacher can develop in the student an increasing respect for the power which resides in his hands when he really understands the nature of the relationship between varying quantities. The concept of relation is the heart of the problem-solving process, for no problem has ever been or ever will be

satisfactorily solved until the nature of the relationship between the variables involved is recognized and understood. To detect these relations, to express them symbolically in the language of mathematics, and to study their behavior under the ever present process of change is to develop powers essential to the general education of our citizens as well as of large value in the study of advanced mathematics.

Among recognized weaknesses in the teaching of mathematics is an over emphasis on the development of operational skill at the expense of growth in conceptual insights. Mathematics is far more than a body of operational techniques, and our responsibilities do not end with the development of skillful computers. The operations and skills of mathematics are important. In fact, their importance in dealing with the physical problems of our environment cannot be exaggerated, but they will never serve any useful purpose unless associated with them are conceptual insights of even more importance because they are essential to the selection of the needed operations. Responsible citizenship in a democracy cannot be expected from young men and women who are operators only, for they are no more adequately equipped to apply the methods and procedures of mathematics to the solution of the problems with which they are daily confronted than is the sluggish elephant on a circus platform who demonstrates his ability to add two and three. They are like the snakes of Noah's ark who, in response to the command of the Lord to go out and multiply, replied that they were unable to obey because they were adders.

To develop operational skill at the expense of operational insights is really wasted effort. Few students, for example, on either the high-school or college level recognize counting as *the* fundamental operation which is independent of the structure of the number system and which is actually the operation of placing the positive integers into one-to-one correspondence with the set of objects being counted. Nor do they understand the mutually inverse character of the so-called fundamental operations and the fact that this property extends to involution and evolution, logarithmation and antilogarithmation, differentiation and integration. With the extension of the number system to include new numbers, operations hitherto impossible within the system of positive integers may then be possible. This is an important principle and it is one which escapes many of our students. Subtraction, for example, is always possible in a number system extended to include negative numbers and, when rational numbers are included, division becomes always possible, except when the divisor is zero.

The power of mathematics resides in the quality of its symbolism which is a principle all too frequently neglected in the teaching of mathematics. From the influential pen of John Dewey comes the significant statement that "the invention of symbols is doubtless by far the single greatest invention in the history of man" for it is through well-selected symbols

that his intellectual power is increased and he can recognize relations which in more primitive cultures would be forever hidden by the crude and awkward character of the symbolism used. Consider, for example, the difficulty of finding the product of eighty-four and thirty-seven when these numbers are expressed in the symbolism of the Romans with that of computing their product through the use of the Hindu-Arabic numerals. The extent to which mathematics has acquired an effective form of expression measures the degree to which it has become a useful mode of thinking and, from the simple symbols of the early grades to the more complex symbolism of the calculus, the teaching of mathematics provides a continuing opportunity to impress the student with the important fact that well-selected symbols will increase his intellectual power.

It should be emphasized, however, that this abstract quality of mathematical language responsible for its power and precision is at the same time the source of large difficulty. Symbols stand for ideas and to *give* the student a symbol for an idea he does not have is to encourage him to take his first step on the all-too-short road to intellectual disaster. Nothing is more deadly than the meaningless manipulation of empty symbols and anything which appears to promote this vicious practice should forever be avoided. The development of ideas has first claim on the efforts of a teacher and, once an idea has been born in the intellectual world of the student, it is desirable and economical to attach a symbol to it.

In contrast to the concept of measurement "which looks to the external world of outer reality lying in time and space," there is the concept of proof which "looks to the inner realm of order and consistency among the propositions and principles" of a slowly evolving rational structure. The one provides a means by which to bring under control the mighty forces of nature while the other seeks to extend the inner realm of relations among mathematical ideas themselves. Each is important and in addition to the measurement concept a student should learn to appreciate mathematics as an ordered system of ideas. From the checking of results in the early grades through the testing of generalizations established by inductive reasoning to the organizing of deductive proofs in later mathematics, the student should be guided toward an increasing insight into what it really means to prove anything. To develop a generation of young men and women who really understand the importance of clearly defined terms, who recognize the role of assumptions in any ordered discussion, who are able to detect implicit assumptions, and who know what it means to challenge an assumption is to take a long step forward in a forthright attack on loose and disjointed thinking.

Among the problems associated with the role of mathematics in general education is the problem of selecting content which not only contributes to effective citizenship in a democratic culture, but, at the same time, provides a solid base for advanced study in the area. I have suggested six unifying concepts which might serve as guides in the selection of con-

tent to be developed in such a manner that "the special forever flows out of the general and forever returns to enrich it". . . . To develop the potentialities inherent in such a program calls for great teaching since it is indeed true that content cannot be divorced from method. Learning is a function of both content and method. It is as personal as one's own toothbrush. No one can *give* an education to *any* student, but a great teacher can make the long educational continuum so inviting that he learns to educate himself. The greatness of a teacher is largely determined by the extent to which he releases the measure of greatness which resides in every student. It calls for large mathematical insights as well as large human insights, all of which will be reflected as the student is guided toward the achievement of his highest potentialities.

Problems of Mathematics in the Small High School

MILTON W. BECKMANN

WHEN, in this Atomic Age and the present state of world affairs, we are told that our overseas antagonists are out-distancing us in the development of young engineers and scientists, it is a matter of deep concern among teachers of mathematics. We are in a position where we can help to eliminate this situation. There are a number of ways in which we can solve our shortage problem. One way to help is to develop the latent talent or potential in our boys and girls in the small high schools.

Techniques necessary and desirable in large high schools may not be effective or economical in small schools. For example, a high degree of teacher specialization is necessary in large schools, but not feasible in small schools. Other problems of mathematics in the small school will be discussed and suggestions made for their solutions, but first a few paragraphs will be devoted to the revelation of potential in the small school which must be tapped.

Many people have no conception of the large number of pupils enrolled in the small schools. Let us define the small high school as one enrolling 150 or fewer pupils. Figures on enrollment of several states will serve as an eye opener.

Colorado presently has 265 high schools of which 165 (with 10,000 pupils) have fewer than 150 enrolled in grades 9-12.[1] Sixty-two per cent of the Colorado high schools fall in the category of the small school. Wisconsin has 445 high schools, one fourth of them enrolling fewer than 100 pupils.

[1] *Summary of the Conference on Improvement of the Small High School*, Lincoln, Nebraska, March 13-14, 1958, p. 2.

Milton W. Beckmann is Supervisor of Mathematics and Associate Professor of Secondary Education, University of Nebraska, Lincoln, Nebraska.

Henry Knapp just recently completed a study[2] of small high schools. It reveals the salient facts derived from an investigation of small high schools in six mountain states. The results are found in Tables I and II.

TABLE I. High Schools with 100 or More Pupils and with Fewer Than 100

	Idaho	*Mont.*	*Wyo.*	*Colo.*	*Utah*	*Nev.*	*Six-State Area*
(100–)	88	78	33	126	63	18	406
(4–99)	39	96	53	139	14	19	360
Total	127	174	86	265	77	37	766

TABLE II. Total Number of High Schools in Six-State Area with Fewer Than 100 Pupils

	Idaho	*Mont.*	*Wyo.*	*Colo.*	*Utah*	*Nev.*	*Six-State Area*
(75–99)	10	19	11	34	8	4	86
(50–74)	13	31	13	35	4	4	100
(25–49)	14	35	22	49	2	7	129
(4–24)	2	11	7	21	—	4	45
Total	39	96	53	139	14	19	360

The top three rows of figures show the number of high schools with 100 or more pupils, and with less than 100, and the total number of high schools in each state and in the whole six-state area. Below these figures is a more detailed report on the number of high schools with enrollments of fewer than 100.

Should we in Nebraska neglect the potential in mathematics of those pupils in the small schools, the loss would be tremendous. Seventy-eight per cent of the high schools of Nebraska enroll 150 or fewer pupils and thirty-three per cent of the students in Nebraska are enrolled in these schools. The median enrollment is 65 pupils. The median for the number of teachers employed in the Nebraska Schools is 5½. Let us study the tables[3] below. Approximately one half of the high schools of Nebraska have five or fewer teachers.

If space were available, it would be interesting to tabulate enrollments in high schools for all states of the union. The small high schools enroll more than a million pupils. Oh yes, even the Catskills area in New York has a large number of small high schools. I reiterate that there is a tremendous potential of young engineers and scientists in the small high schools. You will agree that this fact has been established.

[2] *Ibid.*, p. 6.
[3] Nebraska State Department of Education, School Year 1955-1956.

TABLE III. Enrollments in Nebraska High Schools

Size of School	*Number of schools*	*Per cent of schools*	*Per cent of pupils*
0–50	120	33	7
51–100	115	32	15
101–150	46	13	11
151–200	21	6	7
Total	302	84	40

TABLE IV. Relathionship Between Number of Students Enrolled and Number of Teachers Employed

Number of schools	*Number of teachers*	*Per cent of schools*
1	1	.2
11	2	2.5
75	3	17.4
59	4	13.6
68	5	15.7
		49.4

Limited mathematics course offerings is one of the major problems in the small high school. A study[4] made by Barry S. Moore places this problem in the limelight. This study includes all 460 high schools in Nebraska. Ninety-two per cent of them offer Algebra 1, 75 per cent offer General Mathematics, 77 per cent offer Plane Geometry, 42 per cent offer Second-Year Algebra, but only 9 per cent offer Trigonometry. Six per cent offered Solid Geometry, and only 9 per cent offer an advanced mathematics course beyond Second-Year Algebra.

When only the small high school is considered, the picture looks gloomier. For example, only 4 per cent of the schools with enrollments between 51-100 offer Trigonometry. A solution for this problem is supervised correspondence study. During the school year 1957-58, there were 10,492 course enrollments processed by the Nebraska program of supervised correspondence study. Of the total enrollments about 40 per cent are from Nebraska, 55 per cent from other states, and 5 per cent from foreign countries. Supervised correspondence is, for the most part, included in the high-school program of the student as a means of providing a course or courses not otherwise available because of small demand, lack of a qualified teacher, late registration, or transfer from another school. Supervised correspondence study (SCS) also provides education for the isolated or homebound child, and it may be used for

[4]Moore, Barry S., *The Mathematics Teacher*, "Mathematics Course Offerings and Enrollments in Nebraska Public Schools," University of Nebraska, Lincoln, Nebraska, 1957, p. 37.

summer study to facilitate acceleration or the regaining of ground lost for one reason or another. American pupils overseas and institutionalized individuals use SCS in order to obtain schooling.

How does the achievement of pupils who take courses of supervised correspondence study compare with the achievement of pupils who receive instruction in similar courses in regular classroom situations? Childs completed a study[5] in which he answered this question. He concluded: "This study compares the achievement of 79 students who completed certain high-school mathematics courses by correspondence study with the University of Nebraska Extension Division during the years 1940 to 1950 and who later enrolled for mathematics instruction at the University of Nebraska, with the achievement of 79 students with no correspondence experience in high school who studied in the same initial university mathematics classes as those in which the correspondence students were enrolled. Control variables employed were scores on the placement examinations given at the time of entrance to the university. Achievement was determined by final class marks received. The average class mark received by members of the group with high-school experience in correspondence study was 5.96 on the university 9-point grading scale, whereas the average class mark received by the non-correspondence study group was 5.00. There was thus an unadjusted mean difference of .96 points in favor of the correspondence group. When the means were adjusted to take into account the control variables, this difference was found to be .66. The significance of this difference was determined by use of the method of analysis of covariance. It was found to be significant at the 4 per cent level of confidence.

". . . . This paper does not attempt to establish the reason for the indicated superiority of the correspondence over the non-correspondence group. In terms of prospective success in college mathematics, the reason is immaterial. What is indicated is that pupils who have studied mathematics by correspondence study in high school are, on the average, likely to succeed somewhat better than those students of comparable ability who have not had this experience.

Inadequate preparation of mathematics teachers is another problem of the small school. Moore's study[6] also shows the numbers and percentages of mathematics teachers having earned certain numbers of hours in mathematics. The study included 711 who were teaching mathematics. Approximately 79 per cent of the 711 teachers had earned 15 or more hours in mathematics. Approximately 89 per cent of the 127 mathematics teachers in the enrollment group of over 500 pupils (size of school) had earned 15 or more hours in mathematics while only about 50.5 per cent of the 164 teachers in the 0-50 enrollment group earned a like number. Slightly over 38 per cent of the 711 mathematics teachers had a prepara-

[5]Childs, G. B., "Success in Initial University Mathematics Courses of Students with Correspondence and Non-Correspondence Backgrounds in High School Mathematics," *Journal of Educational Research*, April 1956.

tion of 24 or more hours in mathematics while only about 16 per cent of the 164 teachers in the 0-50 enrollment group earned a like number.

What immediate steps can be taken to remedy this situation? Many colleges and universities are offering evening or Saturday classes in mathematics. Teachers are encouraged to enroll.

The National Council of Teachers of Mathematics has for its object the advancement of mathematics teaching at all levels of instruction. Those persons teaching mathematics should become members of this organization. *The Mathematics Teacher,* the official journal of the National Council of Teachers of Mathematics, will keep them informed of new programs in mathematics, convey new techniques, stimulate, refresh and upgrade teachers at all levels. The yearbooks of this organization would prove exceedingly helpful.

An organization that is doing a great deal of work toward improving the high-school mathematics curriculum is the Commission on Mathematics of the College Entrance Examination Board. Establishment of a truly modern curriculum in college preparatory mathematics is the primary objective of the Commission. The Commission has undertaken this task in the belief that proper mathematical instruction in high school is of the utmost importance in the scientific and technical education of our young people, and that the present curriculum is badly adapted to the actual needs of our students. The changing needs of science and technology, recent development in mathematics itself, the importance of mathematics in general education now require the adoption of new points of view toward many portions of elementary mathematics and the replacement of certain topics, which once were of importance, with others which are now considered to be of even greater importance.

Every administrator should make sure that his high-school mathematics department is receiving the publications and progress reports of the Commission on Mathematics. May I urge you, the principal, to obtain these. One or more members of your schools board, particularly any one who may have some background of mathematical study in college, might like to receive them. The Commission will be glad to place your name on its mailing list upon request. Address the Commission on Mathematics, 425 West 117 Street, New York 27, N. Y.

To become better prepared in mathematics, teachers should be encouraged by their administrators to attend summer schools, conferences, workshops, and institutes.

Another procedure to be considered for the solution of the problem is educational television. The school operating with classroom teaching alone can conceal its failures. When pupils must stand up against those from other schools, the situation is available for all to see. For further comments concerning educational TV, the reader is encouraged to read Chapter V in this BULLETIN where this subject is so ably discussed.

[9]Moore, *op. cit.*, p. 9.

Inadequate supply of mathematics books for the library is a problem in both the small and large high schools. It is true that our budgets are always limited, but, usually when comparing the number of books for the mathematics department with the social studies, home economics, or English departments, we find only a few mathematics books. It has been my experience that teachers just do not request library materials. A great deal is being said about teaching superior students topology, sets, non-Euclidean geometry, other number bases, and so on. How better can the student acquaint himself with this material than by finding it in the library? Any one or a dozen of these books may prove a source of inspiration to some student. These books will also deepen and broaden the teacher's understanding of mathematics.

Congress, just before adjournment in August, appropriated $900 million for student loans, language development, research in educational television, expansion of graduate education, and Federal aid to education in mathematics, science, and vocational education. It is hoped that administrators and teachers of mathematics will take advantage of this appropriation.

A number of methods have been discussed which might be used to add flexibility, quality, and depth to the programs of the small high schools. Three other methods which should also be considered but will not be discussed are: multiple classes, school aides and flexible scheduling.

Will not the initiation of procedures described throughout this article result in prolonging the existence of small high schools whose existence might be difficult to justify? States working on the establishment of larger attendance areas and larger administrative units where such are feasible and desirable should continue to do so. Sound reorganization of attendance and administrative units should not be held up because the small high school can provide an excellent instructional program. There is other justification for reorganization, for example, efficiency. We cannot sacrifice boys and girls in small schools today by denying them better schools, in the hope that larger schools will be obtained sooner if small schools are kept inferior.

During the Conference on Improvement of the Small School held in Lincoln on March 13-14, 1958, three pertinent points were made relative to the perpetuation of the small school:

1. Investigation has not established any clear-cut correlation between the size of the high school and the quality of learning. In Illinois with all the consolidation that has been carried on the only result has been more music and art and better equipped laboratories. Learning itself is not at a higher level.

2. Small high schools have inherent points of strength which can be capitalized on—for example, attention to the individual and good human relations. In fact, large high schools are now working actively to reorganize into what amounts to small high schools within schools.

3. Industrial leaders and sociologists see clearly the evils of bigness and are encouraging the break up of industry and society into smaller suburban

groups served by small high schools. We will always have small high schools and many of them. The science of improving the small high schools must proceed with all speed possible.

It is morally not defensible to deny youth now in small high schools the best mathematics education available today.

Experiences with Some Different Topics for Slow Learners

STEPHEN KRULIK

AS THE most vigorous democracy in the world today, it is not surprising that the United States should be the world leader in providing the opportunity for a high-school education for all youth. It is within this broad context of secondary education that the program for slow learners must be viewed. In fact, due to the recent advent of "crash" programs in mathematics for the gifted, it becomes more important than ever to re-examine our program for the pupil who will not continue beyond high school.

First of all, who is a slow learner? He is not any one type, but a variation of many types. He has the same basic needs as other pupils. He has the same amount of variability and unevenness of abilities. "Slow learner" refers to the capacity of the individual to learn intellectual things. At best the term is a rather unsatisfactory one. A "slow learner" means just that—he learns slowly. But he can learn!! And learn a lot of good mathematics!!

For this article, four criteria were adopted for determining whether or not a pupil was a true slow learner:

1. The pupil had to have an I.Q. between 70 and 90. In the school, as in most of New York City, the *Pintner Test* of Mental Abilities was used. Since this test has a reliability of .91, it was felt that the test would yield true indications of slow learningness.
2. The pupil's reading level had to show a retardation of at least two years on the *Stanford Reading Achievement Test*.
3. The third criterion was that the pupil's score on the *New York City Arithmetic Achievement Test* had to be at least two years retarded.
4. Finally, and perhaps the most important of all, was the opinion of the pupil's previous teachers. Was the pupil really a slow learner, or was he just being "dumped" into a special class?

School Background

The school is a new junior high school in the Bedford-Stuyvesant section of Brooklyn. The staff consists of 80 per cent substitutes, 10 per cent

Stephen Krulik is with the New York City High School Department.

regular teachers, and 10 per cent out-of-license people. The neighborhood is extremely poor, with a very high rate of juvenile delinquency. The school has been designated as a "special services," or "subject," school by the city board of education.

The classes consisted of thirty pupils who seemed to be true slow learners. As far as they knew, they were like any regular class. They were not specially designated and followed a regular program. They traveled from room to room for each subject and had a different teacher for each. The classes contained about the same number of girls as boys.

Procedure

As soon as one topic had ended, a regular pair of dice was brought out. A pupil was sent to the board, and a "frequency table" was constructed for the rolls of the dice. (Of course there were many snickers, laughs, and side remarks which were ignored.) After about 40 rolls of the dice, the pupils obtained a curve which appeared to represent a normal distribution. At this point, a die with only 5's on it was substituted for one of the pair, and the tabulations continued for the new pair. After about ten or fifteen rolls, several pupils began to comment on the "odd" numbers which the dice were producing.

After the dice, we turned to tossing pennies and graphing the results. In this manner, we developed the idea of a central tendency, and the use of averages. Now, of course, at this point there are two obvious questions to be asked. First, why choose statistical concepts to teach these youngsters, and second, how far can we go with a "slow learner"?

To answer the first, we suggest you read the front page of almost any newspaper, on almost any topic, on almost any day. It has become impossible to read intelligently, unless we can understand elementary statistical concepts. Words like "mean," "median," "mode," "random sample," "average," "central tendency," "probability," and so on have become an integral part of our everyday vocabulary. Then too, the arithmetic processes needed in the simple statistical computations will suffice to give the pupils much-needed practice in the basic manipulative skills, which are often weak.

As to the second question, let me relate what these pupils learned. They discovered the meaning and use of a mean, a median, and a mode. They discussed when to use each, how to compute each, and actually put them into practice. The pupils were able to use out-of-class situations in which to apply these concepts. They conducted a straw poll for the G.O. elections; they found a class "average man" and "average woman."

Of course the above accounts sounds fine in theory, but how much of it was actually retained? And for how long? The unit was taught in October, and the early part of November. Immediately after completion, as a usual procedure, the pupils received a unit test. Of the class of thirty, twenty-three, or 77 per cent scored a grade of 65 or better. Nine, had

scores above 90 per cent. The following June, on a final exam, the pupils were given ten question on this unit. Of the twenty-nine left in the group, twenty pupils, or 69 per cent had 7 or more correctly done. Nine pupils had all ten correct. And, remember, *this was seven months later.*

A second topic which was used with some degree of success was a unit on the *language of sets.* The pupils formulated a definition of a finite set, and spent some time counting members of sets in the room. The set of windows in the room, the set of male pupils, the set of female pupils, the set of classes in the school, the set of rooms in the school, and so on, formed the initial sets. Soon we were able to discuss the abstract sets, as the set of even numbers from two to twelve, the set of integers from eight to seventeen, and so on. The pupils commented on the fact that many of our sets were the same in number, as the set of classrooms, the set of teachers, the set of classes, and so on. This was the beginning of the concept of set equivalency, or a one-to-one correspondence.

We were able to define two operations with sets; namely, the "union" and "intersection" of sets. We defined the "union" of sets as "the set of elements which are in either set, or both." We reached the stage where we were able to use the symbol "U" for union.

Similarly, we were able to define the "intersection" of two sets as "the set of elements common to both sets." Again, we were able to use the symbol "$\cap$" for intersection.

We discovered that the "union of the set of boy pupils and the set of girl pupils," gave us the "set of all pupils"; the "union of the even integers with the odd integers (gave us) the set of all integers." Similarly, we were able to discuss many problems with the intersection of sets. We reached the stage where pupils could find the answer to problems such as this one:

$$\{1, 2, 3,\} \cap \{3, 4, 5,\} = \{3\}$$

Since little is available for this sort of work in textbooks, most of the material had to mimeographed. This, of course, led to several administrative problems which were overcome.

Results

Aside from the academic results attained, the class attitude was radically altered. Cutting dropped off from two or three a day, to, at most, once a week. The class attitude towards homework was changed also. Each pupil did his homework, and usually it was quite correctly done, too. The atmosphere in class also changed. Where the pupils had been quiet, bored, and occasionally troublesome, they now became awake, attentive, and even volunteered information.

What were the reasons for these changes? We believe they can best be summarized as follows:

1. Here was a class in which the students were doing some real mathematics. This was new material. They were no longer just rehashing areas of previous failure.
2. This mathematics was meaningful to them. It was not just a series of symbols, and a chore to accomplish. Much of their work was out of class, and interesting to them.
3. The prestige factor was enormous. Here were these slow pupils, always at the bottom of the heap, never showing any progress. Now, they had some mathematics to "show off" to their less-fortunate brighter friends.
4. Finally, they came to understand and appreciate real mathematics. This was mathematics they could learn, they could understand, and they could enjoy!

If we keep in mind that a slow learner *can* learn, and if we try to teach him some good mathematics, not *watered down material* from the college-bound pupil's curriculum, but material geared to his needs, then we can accomplish much with these pupils.

A General Mathematics Program for a Large High School

IDA A. OSTRANDER

THE mathematics programs in our high schools are under close surveillance. This is most desirable, for a scientific age certainly requires most adequate mathematics instruction.

The program described below is used in a school system operating on the junior-senior high-school plan. The schools are comprehensive high schools with a population of approximately a thousand in junior high school and an equal number in senior high school. The intelligence quotients range from the very superior plus to the very inferior minus. The economic backgrounds and vocations of the parents vary widely as does the education. This is a truly representative American Community. The underlying philosophy of the curriculum stresses the development of each pupil according to his interest and ability as nearly as possible. The mathematics curriculum, which will carry out or approach this aim, must be broad in scope. In an effort to meet this objective, the mathematics program set forth below has evolved.

Throughout the program, the courses of study emphasize General Mathematics. During each year, arithmetic, algebra, and geometry are studied. As the pupil's experiences are enlarged, new concepts are pre-

Ida A. Ostrander, Sewanhaka High School, Floral Park, New York.

sented to him. In this way, the pupil continues to enrich his mathematical background. Mathematics 7, 8, 9, (required of every student) is an integrated sequence (General Mathematics) which aims to develop each student's competency in mathematics. During the seventh and eighth grade, the work is organized around arithmetic, informal geometry, and an introduction to algebra.

In seventh grade, the pupil reviews his fundamental concepts of arithmetic, extends his ideas of decimals and fractions as related to percentage. He enlarges his geometry concepts. He develops the meaning of an angle; learns specific properties of plane figures. Then by using ruler and protractor, he measures and constructs figures accurately. He also develops appreciation of geometric designs through his constructions. He develops the formulas for the perimeter and area of the plane figures. Through the development of the formula, he begins to understand algebra. He learns to express mathematical relationships graphically by using line, bar, and circle graphs.

In eighth grade, he continues his use of arithmetic, applying it to social usage; for example, budgets, insurance, taxation, and interest. He becomes aware of large numbers as used in the space age, astronomy, and currency, and small numbers employed in scientific measure. In the field of geometry, he studies the three dimensional world and develops concepts and principles of measurement of common rectangular solids and cylinders. He learns to recognize congruent, similar, and symmetric figures. He reviews direct measurement and learns the importance of indirect measurement. He begins to express simple algebraic relationship in terms of symbols. He then relates this to formula and simple equations.

However, in the ninth grade, the pupil should be provided with a differentiated program. The background of each pupil needs to be carefully scrutinized. His past performance in mathematics, a prognostic algebra test, his intelligence quotient, and his reading ability along with recommendations from his mathematics teacher need to be considered. The pupil will be directed to the course best suited to his needs.

A four-track program in the ninth year has been inaugurated; Track 1—Ninth-Grade Mathematics (Algebra for superior), Track 2—Algebra, Track 3—General Mathematics, Track 4—Basic Mathematics. (In Ninth-Year Mathematics, the core for both Track 1 and 2 of the year is Algebra.) The meaning of numbers is stressed; the number system is extended to negative numbers, and the fundamental operations, including those with negative numbers, of adding, subtracting, multiplying, and dividing, are continually maintained. The laws of algebra are deveolped, making sure the pupil makes use of the associative, distributive, and commutative laws. The study of the linear equation is one of the main topics. The graphing of the linear equation offers interesting geometry concepts. The pupil should develop the slope-intercept method. This relates directly to the tangent in the trigonometric functions. Similar triangles are brought in again when the trigonometirc ratios (sine, cosine, and tangent) are

developed, and then a one-to-one ratio, making congruent triangles, continues to extend the geometric concept. In all topics, including factoring, fractions, fractional equations, radicals, arithmetic processes are continually reviewed. The ninth-grade superior algebra group enriches the various topics. For example, in quadratic equations, they develop the general formula from the completion of the square. The solution of inequalities is studied.

The third track in the ninth-grade approach will study geometry, largely from measurement and construction, they will apply arithmetic in social aspects of living, such as using a car, operating a home, personal and family living. They will also interpret their environment through the use of graphs. They will use algebra in formulas.

The fourth track, basic mathematics, helps those pupils who have difficulty with their arithmetic fundamentals. The individual need of each pupil helps him overcome his weaknesses. He also studies the mathematics which he encounters in daily living.

In the tenth year, the mathematics program provides diverse opportunities also. The students, who have satisfactorily completed ninth-year mathematics and have shown excellent aptitude on a geometry prognostic test, are advised to study tenth-year mathematics. Again it has been found educationally sound to place the superior students in mathematics in one class. The tenth-year mathematics student reviews his intuitive geometry. He is introduced to the meaning of proof. Four geometric sequences help him develop meaning of sequential thinking. Coordinate geometry relates his algebra and geometry. Through this he extends the meaning of slope intercept, develops the length of a line segment formula, and finds the midpoint of a line. Now using this analytical geometry, he can prove many geometry originals. Experimentation to cover the work in Solid Geometry during the tenth-year mathematics should be started.

A second program in the tenth year is planned for the student who cannot profit from a course in algebra in the ninth year. The mathematics taught in this course again needs to present materials from arithmetic, algebra, and geometry. Such units as scale drawing, blue print reading, finding areas, have proved very worth while, especially to boys who are entering industry directly after high-school graduation. A laboratory approach to this work proves a good way to present this course.

During the eleventh year, the pupil is well aware of his own aptitude in mathematics. The student who has shown excellent profiency, studies eleventh-year mathematics. Here he extends his work in algebra to include the theory and solution of quadratic equations, the extension of the number system to imaginaries, exponents and their application to common logarithms, and study of trigonometry, with emphasis on the trigonometric functions of a general angle. The application of logarithms to the solution of triangles is de-emphasized. Graphing the conic sections with a linear equation and graphing the trigonometric functions are also stressed. The use of coordinate geometry continues; reviewing slope, length of line

segments. Throughout the eleventh year, the pupils realize the interrelationship of arithmetic, algebra, and geometry.

For the students in the eleventh grade who cannot move quite so rapidly, the eleventh year may be devoted entirely to Intermediate Algebra. This course covers all the algebra work of eleventh-year mathematics, and includes only the trigonometry of the right angle.

Opportunity is provided for the third track student also. Two half-year courses have proved beneficial. The one is surveying. This is a laboratory course, where the pupils learn to use the protractor and compasses to determine and measure angles of open and closed traverses, employee-scale measure, make maps of various plots using the transit, find the area of the plots, and solve triangles using laws of sines and cosines.

The other half-year course designed for young adults is Consumer Mathematics. Life insurance, automobile insurance, social security, preparing for nursing, and civil service examinations have proved important topics. Many of these problems are now vital to them. (Introduction to statistics and interpretation of graphs are also taught.)

The offerings for the twelfth year in mathematics now can provide enriched opportunities for the superior. The twelfth-year course for the superior attempts to integrate topics from algebra, analytic geometry, spatial geometry, trigonometry, introductory calculus, and some new subject matter from modern mathematics. (Probability and statistics will also be covered during this year.)

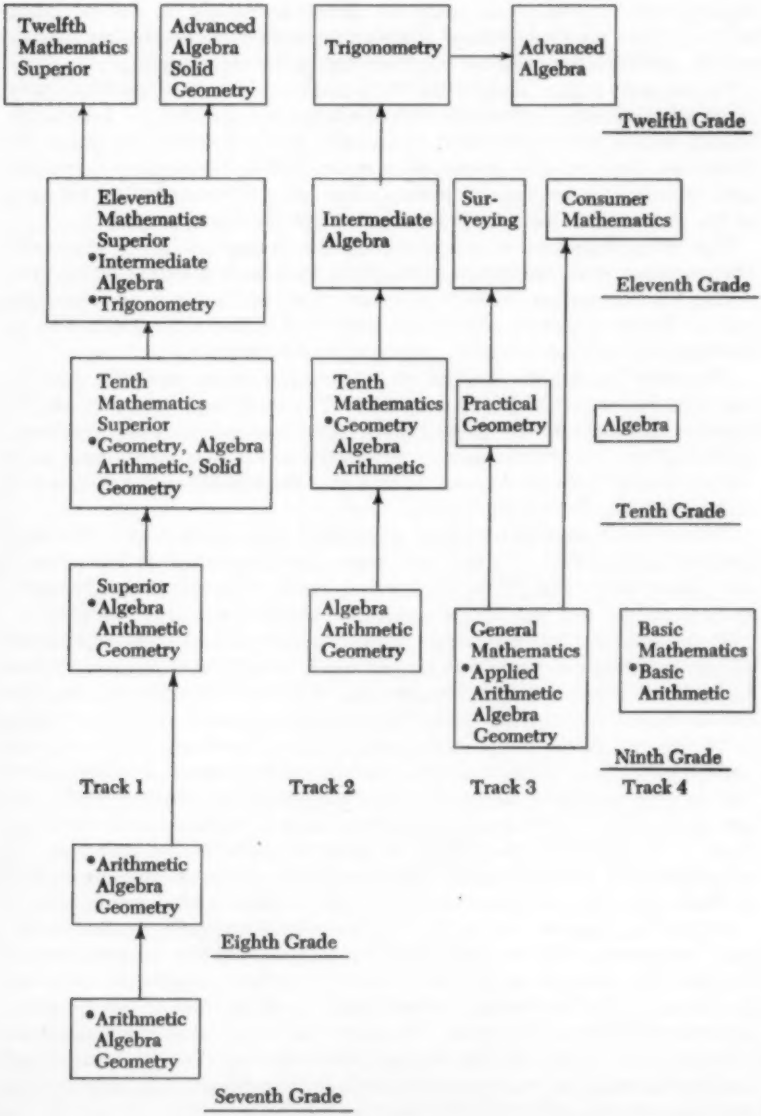
Trigonometry may be offered in the twelfth year to the pupils who have studied Intermediate Algebra for a year. The trigonometric functions of the general angle should be emphasized again. The solution of triangles and logarithms will play a less important role than previous years.

In the twelfth year, the usual courses are Advanced Algebra and Solid Geometry. In a few years, the subject matter from these two courses can be fitted into the tenth and eleventh year. This will leave the twelfth year free to emphasize statistics, probability, and introductory work in calculus.

The success of the program depends on the joint efforts of the teachers and pupils. Mathematics teachers who are vitally interested in their work are attending summer institutes, some sponsored by industry; workshops set up for mathematics teachers; and institutes sponsored by the National Science Foundation. They have worked diligently to keep alert to the needs of youth in mathematics. They are aware of the changes in modern mathematics; they realize many courses should be modified and improved.

With this program, the pupils who have superior mathematical ability are recognized. They are well prepared to continue the study of mathematics and prepare to be mathematics teachers, engineers, research mathematicians, actuarians, statisticians, and to follow many other careers allied to mathematics. Those who wish to enter other academic and technical work have also had suitable training. The group who will use mathematics as consumers and earners have been made aware of the mathematics they will meet in everyday living.

A POSSIBLE SEQUENCE IN A GENERAL MATHEMATICS PROGRAM FOR A LARGE HIGH SCHOOL



The Place of Mathematics in a Liberal Education

WILLIAM H. GLENN

THE primary purposes of teaching mathematics is to develop those powers of understanding and of analyzing relations of quantity (number) and of space which are necessary to an insight into and control over our environment, and to an apprciation of the progress of civilization in its various aspects. Each pupil will successfully meet this purpose to the degree that he: (1) develops a vocabulary to think quantitatively, (2) solves problems of everyday living which require the use of mathematics, (3) appreciates the orderly system of mathematics and its significant contribution to civilization, and (4) solves problems of a mathematical nature that are necessary in preparing for a specific vocation.

The junior high schools in Pasadena have accepted the philosophy that student needs will be better served in accomplishing these purposes by ability grouping, which fall in these major categories: (1) the mathematically gifted–for whom there is an accelerated program in which Algebra is taken in the eighth grade, followed by each succeeding mathematics course until the twelfth grade where an advanced placement program is offered, (2) the better than average, (3) the average, (4) the below average, and (5) the mentally retarded.

Arithmetic in the seventh and eighth grades carries the pupils through the study of percentage and its many applications in business and science. Problems involving measurement of distances, areas, and volumes are also taught. Meaningful applications keep the skills alive in performing the four fundamental processes of addition, subtraction, multiplication, and division with whole numbers, fractions, and decimals. In order to lay a foundation for algebra, extensive use is made of indicated operations to express numerical relations.

It is in the seventh and eighth grades that teachers need to be emphasizing the power of mathematics, by pointing out important generalizations. These can best be shown by using the language of algebra. The basic indicated operation forms are as follows: $8 + 2$ indicates addition; $8 - 2$ indicates subtraction; $(8)(2)$ or $8(2)$ indicates multiplication; $\frac{8}{2}$ indicates division; and $8^2 = (8)\ (8)$ indicates repeated multiplication.

Skill in writing and interpreting mathematical expressions comes about by having pupils translate the English expressions of every word problem into mathematical sentences using the indicated operation forms. In effect this says to the pupil, "Show what the problem says to do and then do it." For example, consider the following problem: "John bought 4 items that cost \$3 each. He gave the clerk a \$20 bill. How much change did he re-

William H. Glenn is Coordinator of Mathematics in the Pasadena City Schools, Pasadena, California.

ceive?" The solution, in indicated operation form, is \$20 — 4(\$3); and carrying out the steps leads to the numerical answer, \$20 — 4(\$3) = \$20 — \$12 = \$8. Unless a pupil is told otherwise, an expression like 20 — 4(3) might be solved differently. Some might read this as "20 minus 4 is 16, and 16 times 3 is 48."

Thus pupils recognize the need to agree that rules are necessary if everyone is to obtain the same answer. A rule such as, "multiply first and then subtract," becomes quite reasonable and pupils see why it is necessary. If subtraction were to be done first, and then multiplication, the expression would be written as $(20-4)(3)$ which equals $16(3)$ or 48.

Another illustration of using indicated operations points up the beauty of number relationships which would be non-existent unless the symbols of indicated operation were used. The following array is a good example of this:

$$0 \times 9 + 1 = 1$$
$$1 \times 9 + 2 = 11$$
$$12 \times 9 + 3 = 111$$
$$123 \times 9 + 4 = 1111$$
$$1234 \times 9 + 5 = 11111$$

and so forth.

By dealing with fractions, pupils can see that

$$\frac{1}{2} = \frac{2}{4}$$

is the same as $\frac{1}{2} = \frac{1(2)}{2(2)}$ or $\frac{1}{2}\left(\frac{2}{2}\right)$

Also, $\frac{1}{2} = \frac{3}{6}$

is the same as $\frac{1}{2} = \frac{1(3)}{2(3)}$ or $\frac{1}{2}\left(\frac{3}{3}\right)$

and, in general, $\frac{1}{2} = \frac{1(n)}{2(n)}$ or $\frac{1}{2}\left(\frac{n}{n}\right)$ $(n+0)$

In words, this says, "A fraction is still the same value even though its numerator and denominator are each multiplied by n, provided n is not zero." It can also be interpreted as saying that "A fraction is not changed in value if it is multiplied by 1 or $\frac{n}{n}$." Pupils are now ready to see what happens when $n = 50$, for the expression becomes

$$\frac{1}{2} = \frac{50}{100}$$

This leads to the idea of changing any fraction to an equivalent one with 100 as a denominator. The natural next step is to recognize that this is the basic idea behind percentage. Comparing two numbers by division,

such as 30 and 60, and then changing this comparison to a 100 base, is equivalent to writing:

$$\frac{30}{60} = \frac{50}{100}$$

The important generalization is to see that ratio and proportion is the underlying principle of all percentage problems:

$$\frac{\text{part}}{\text{whole}} = \frac{\text{per cent}}{100\%}$$

These are just a few of the many examples illustrating the techniques used in arriving at generalizations. The development of these teaching techniques, through a discovery process, is an important aspect of the work.

In the ninth grade, pupils may elect General Mathematics or Algebra. General Mathematics has a two-fold purpose. For some, it will necessarily be remedial arithmetic for the entire year, with applications taken from the problems of the home, shop, business, and science. For others, it should include a review of arithmetic and ultimately exploratory work preparing for algebra.

Comparing the total number enrolled in a subject with the total number of pupils in the grade at which this subject is normally taught shows the following per cents in 1957:

Algebra I	85.9%
Plane Geometry AB	62.1%
Algebra II	29.8%
Trigonometry (1st semester)	11.9%
Solid Geometry (2nd semester)	9.7%

Thus, approximately one out of every eleven students graduating from the two high schools in Pasadena have met the four-year requirement for possible entrance in enginering colleges. Many of those who took any or all of this sequence come under the classification of liberal arts students. What has been their gain?

Where the seventh and eighth grades emphasized the bridging of the gap between algebra and arithmetic, through the use of indicated operation forms, the ninth and tenth grades have attempted to capitalize upon the interrelationships of the many areas of mathematics. It has been felt that after a student has had such an overview for two years, in the ninth and tenth grades, he should be in a good position to determine if he likes mathematics, if he is successful in it, and, therefore, if he should continue taking additional courses in it.

Teachers and counselors have been urged to encourage students to take as much mathematics as their interests and capabilities indicate. Any student who does "B" work in the ninth and tenth grades is strongly advised

to continue with mathematics and take a third year. A fourth year is in order if success and interest are still demonstrated at the end of the third year. The third and fourth years are elective for liberal arts students, but required of all who wish to prepare for careers in engineering, science, or mathematics.

Tracking in the eleventh and twelfth grades is arranged, not on the basis of vocational goals but rather on mathematical ability and interest. Thus, liberal arts students are found in both tracks. Students preparing for science, engineering, or mathematics careers are expected to be in the higher track if they are to have an adequate preparation. The essential difference in the two tracks is the depth of penetration of certain topics. For example, the higher track emphasizes the analytical aspects of trigonometry, gives a more thorough treatment of the solution of second-degree curves as well as higher degree curves, and introduces the student to elementary aspects of differential and integral calculus.

The following points have been considered as important changes in the curriculum in recent years:

1. Methods of logic should be applied in all branches of mathematics and not confined exclusively to geometry.

2. Advanced cases of factoring and reduction of complicated expressions have been eliminated in the first two years and postponed to the third and fourth years for the occasions when the methods are needed.

3. Trigonometry is being taught at each grade-level, beginning with numerical trigonometry in the ninth grade. The use of trigonometric functions in solving problems is continued in the tenth and eleventh grades, with major emphasis being given to analytical trigonometry in the twelfth grade.

4. Emphasis in the eleventh grade is given to functions, analytic geometry, topics in advanced algebra, statistics, solid mensuration, and numerical trigonometry. The twelfth grade contains some computational trigonometry, but mostly analytical trigonometry, further work in analytical geometry, and a brief introduction to concepts of differential and integral calculus.

5. Instruction in the slide rule is given in every mathematics course.

6. Once a concept is introduced, every effort is made to maintain the skill.

7. Capitalizing upon the interrelationships of the various areas of mathematics is stressed at each grade. An example of a thread of continuity running through the four-year mathematics sequence, from the ninth through the twelfth grades, is suggested by the following ratios:

$$\frac{20}{60}, \quad \frac{1}{3}, \quad .333\ldots, \quad \frac{a}{b}, \quad \tan\theta, \quad m, \quad \frac{y_2-y_1}{x_2-x_1}, \quad \frac{\Delta y}{\Delta x}, \quad \frac{dy}{dx}$$

In summary, a liberal arts student should receive a broad background in mathematics. An adult level of proficiency should be attained in arithmetic by the end of the eighth grade. This proficiency should be strengthened by a foundation built on an understanding of major concepts, rather than just a set of rules for computing.

It is highly desirable that a college-bound student start his college preparatory mathematics in the ninth grade. Unless he does this, he may find himself, as he approaches high-school graduation, short of mathematics courses needed to carry out his plan for college. Most important of all, these courses should provide an overview of mathematics that will give the student an ability to solve problems of great variety.

A Look at a Multiple Track Mathematics Program

HOWARD L. GALLANT

THE Hillsborough High School multiple track mathematics program was initiated in 1952 when we realized that our junior-senior high-school mathematics offerings were not meeting the needs of *all* our students. We were satisfied with our enriched traditional track, but we were not satisfied with our program for either the academically talented group or the average and below average non-college group. Our goal has been to provide challenging, worth-while, and respectable tracks for all students. We feel that respectability is a *must* for the success of the non-college and remedial and slow learner groups. We have experienced a steady growth in our mathematics enrollment and an excellent cooperation on the part of both student and parent.

The 2100-2500 students in our tenth, eleventh, and twelfth grades come from five "feeder" junior high schools and include city, suburban, and rural agricultural and citrus home environments. Science, engineering, medicine, law, education, management, merchandising, and agriculture are popular choices of the 40 per cent of our students entering college. Business education, science, nursing, shops, vocational agriculture and home economics, diversified cooperative training, and family life education are among the popular choices of non-college students, who after graduation will become homemakers, employees, and businessmen in the local community.

We have materially enriched and revised our traditional track, but it is in our enriched and accelerated track for the academically talented and our basic and survey tracks for the non-college group that we have made the greatest progress. The following chart outlines our program for each grade of the four multiple tracks, and the discussion that follows is concerned with important factors we have considered in the implementation of the program.

Howard L. Gallant is a Mathematics Helping Teacher in the Hillsborough County Public Schools, Tampa, Florida.

HILLSBOROUGH HIGH SCHOOL MULTIPLE TRACK MATHEMATICS PROGRAM

Grade	*Enriched and Accelerated Track for Academically Talented*	*Enriched Regular College Preparatory Track*	*Basis Mathematics 9 and Survey of High-School Mathematics Track*	*Slow Learner and Review and Remedial Track*
Grade 7	Enriched Arithmetic 7	Enriched Arithmetic 7	Enriched Arithmetic 7	Remedial and Slow Learner Classes
Grade 8	Accelerated Arithmetic 8 First-Year Algebra	Enriched Arithmetic 8	Enriched Arithmetic 8	Slow Learner Classes Regular Arithmetic 8
Grade 9	Complete First-Year Algebra Begin Second-Year Algebra Complete Minimum of ½ Year	Enriched First-Year Algebra	Basic Mathematics 9	Slow learner class if needed Basic Mathematics 9
Grade 10	Accelerated Geometry consisting of Plane Geometry—Introduction to Coordinate Geometry Solid Geometry—Slide Rule	Enriched Second-Year Algebra or Regular Enriched Plane Geometry	Survey of High-School Mathematics	Qualified students may take Survey of High-School Mathematics
Grade 11	Review the 1½ years of Algebra taught in junior high school Complete Second-Year Algebra, Trigonometry, and Solid Geometry	Accelerated or Regular Plane Geometry for Students completing Second-Year Algebra in Grade 10 Second-Year Algebra for students completing Plane Geometry in Grade 10	Qualified Students may take First-Year Algebra	
Grade 12	College Alegbra Analytic Geometry Introduction to Calculus Advanced Topics	Trigonometry, Solid Geometry, Slide Rule, Algebra Review, and Advanced Algebra topics using college textbooks	Qualified First-Year Algebra Students from Grade 11 may take Second-Year Algebra or regular Plane Geometry	One-Semester Review and Remedial Class for students with poor mathematics background

I. Enriched and Accelerated Track for Academically Talented Students

Grade 7

With academically talented students already identified and motivated by enrichment activities in the elementary grades, we know at the beginning of the seventh grade which students should have the potential for membership in the academically talented group. However, we prefer to have all students, with the exception of the slow learners and members of the remedial and review classes, meet together for enriched seventh-grade arithmetic. This practice not only insures their being scattered throughout all seventh-grade home rooms where their leadership, cooperation, and academic ability are a challenge and inspiration to the entire group, but also affords a last opportunity for the late maturing or talented but disinterested students to qualify for membership in the group before the final selection and separation takes place.

We emphasize the following goals in our seventh-grade program: (1) eliminate weaknesses in the understanding and use of basic skills and concepts; (2) stress the importance of developing good work and study habits; (3) emphasize that good mathematics students also need to be good in reading and grammar; and (4) provide guidance and motivation for all the academically talented students who should participate in the program provided by the enriched and accelerated track.

Grades 8 and 9

We first ascertain if students and parents understand that participation in the accelerated program is voluntary, but that, once a student qualifies for membership, he will be expected to make an honest effort to remain in the group. We then enlist the cooperation of his parents in providing a favorable home environment. Even though much of the extra time required is gained by the elimination of repeated explanations and routine drill, the student should expect to spend a reasonable amount of time in outside preparation and activities.

The content of the 8th and 9th grade program is as follows:

1. Enriched eighth-grade arithmetic for the first 10 to 14 weeks of the fall semester of the eighth grade.

2. One and one-half years of algebra beginning with First-Year Algebra. Advanced Algebra topics are taught in the eleventh and twelfth grades, but a number of such topics are of enough interest and help to be introduced as exploratory and recreational materials in the ninth grade.

Grade 10

The tenth grade is devoted primarily to a study of geometry and includes:

1. Plane Geometry.
2. An Introduction to Coordinate Geometry.

3. Solid Geometry topics that can be readily integrated with Plane Geometry.
4. Slide Rule Instruction.

Grade 11

1. An initial thorough review of the 1½ years of algebra completed in the eighth and ninth grades.
2. The Second-Year Algebra course is then completed, introducing, as time permits, timely and motivating Advanced Algebra topics.
3. The first 10 to 12 weeks of the second semester are spent studying Trigonometry.
4. In the remaining 6 to 8 weeks the essential Solid Geometry topics that were not covered in the tenth grade are presented.

Grade 12

1. The textbooks and supplementary materials we use in the twelfth grade are regular college editions.
2. In our Advanced Algebra, we include the college level materials that were not covered in the eleventh grade, or that were introduced earlier as exploratory or recreational activities.
3. We include the essentials of a regular Analytic Geometry course.
4. We introduce helpful Calculus procedures earlier than the twelfth grade, but now we provide a good introduction to Calculus and easy applications of both Integral and Differential Calculus. However, we expect to leave the teaching of the regular credit Calculus to the colleges. Our emphasis is on providing a good foundation in mathematics up to the Calculus level.
5. We introduce, as time permits, advanced topics, such as sets, theory of games, statistics, linear programming, *etc.*

II. Enriched Regular College Preparatory

1. First-Year Algebra is also offered in the senior high-school, tenth grade for qualified late maturing students and also for other capable students who need to complete Basic Mathematics 9 before attempting algebra.
2. Qualified students beginning their First-Year Algebra in the tenth grade may complete the regular four-year program in senior high school by taking both Second-Year Algebra and Plane Geometry in the eleventh grade.
3. Our county requires a minimum of two years of mathematics in grades nine through twelve with the exception that an additional year of a vocational subject may be substituted for the second year of mathematics if a student is very poor in mathematics. In this event, the student is granted a General rather than a College Preparatory diploma. Good college-bound students, however, usually complete 3 to 4 years of mathematics in grades nine through twelve. This year, we will have at least eight classes of geometry. The minimum two-year requirement may

be met by satisfactorily completing one of the following combinations: (a) First- and Second-Year Algebra; (b) First-Year Algebra and Plane Geometry.

4. Looking to the future we anticipate that our enriched arithmetic program in grades five through seven will make it possible for *all* students in both the accelerated and regular tracks who have the potential and preparation for beginning their algebra in junior high school to begin their First-Year Algebra not later than the middle of the eighth grade.

III. Basic Mathematics 9 and Survey Mathematics 10

1. We are determined that these courses shall be respectable, worth while, and challenging and that capable students will not consider these courses an easy means of socialized promotion or a dumping ground for poor students. We make extensive use of our mathematics laboratory and library. We are also developing recreational, informational, and exploratory units on topics such as history of numbers, slide rule, buying a home, borrowing money, trigonometry, ratio, proportion, *etc.*

The tenth-grade survey course includes, in addition to the basic operations and concepts from elementary algebra, plane geometry, and trigonometry, such topics as measurement, similarity and proportion, graphing, scales, scale drawing, and mathematics used in science and vocational courses.

2. Senior high-school students usually complete the survey course in the tenth grade, but may postpone it until the eleventh or even the twelfth grade.

3. Even though the two-year mathematics requirement for the General diploma may be met by completing Basic Mathematics 9 and Survey Mathematics 10, it is surprising how many students decide they want to take more mathematics. In this event, the qualified student may elect to take First-Year Algebra in the eleventh grade and also either Second-Year Algebra or Plane Geometry in the twelfth grade. This interest in more mathematics has resulted in our initiating a study to explore the need for a second year of survey mathematics in senior high school.

IV. Slow Learner and Review and Remedial Track

1. We stress the need for seventh-grade remedial and review students to make a special effort to show a marked improvement in basic arithmetic skills if they want to qualify for placement in a regular enriched eighth-grade class.

2. The number of eighth- and ninth-grade slow-learner classes varies inasmuch as it depends on the number of students still in need of slow-learner instruction. Extremely poor mathematics students are advised to substitute the additional year of a vocational subject for tenth-grade survey mathematics. These students, however, are also advised to enroll in the one-semester twelfth-grade review and remedial course.

3. We are encouraged by the improvement slow learner and previously disinterested students make in the senior-year Review and Remedial course. Maturity and an awareness of after-graduation needs and responsibilities often results in a 3 to 4 grade-level gain.

4. The voluntary approach to their need weeds out troublemakers who would be included if the course were compulsory. All eleventh-grade students who have not taken a mathematics course in senior high school or who are known to be badly in the need of additional work concerned with basic operations and concepts are given a Mathematics Literacy test preceding their registration for senior-year subjects. They are individually counseled relative to their need for review and remedial instruction.

5. The course includes the following six-week units: (a) Basic operations and concepts relating to whole numbers, fractions, decimals, and percentage; (b) Measurement, the metric system, basic geometric figures and constructions, and the simple algebraic operations encountered in working with formulas and simple equations; and (c) Applications of mathematics relating to buying, renting, and furnishing a home, borrowing money, insurance, taxes, wages, *etc.*

This briefly is the multiple-track mathematics program we are implementing at Hillsborough High School. We challenge and motivate our academically talented by continuous enrichment and acceleration, but we are equally concerned that respectable and worth-while offerings for all students afford comparable opportunities for appreciation, exploration, motivation, and enrichment.

A Junior High School Principal Views Mathematics in a Liberal Education

DONALD W. LENTZ

Exploration in Mathematics?

CAN American junior high-school mathematics change a world? Perhaps not, but at no place in our educational system can so much be done to stimulate, encourage, and guide young people as in grades seven through nine. Assuming the importance of mathematics in our culture, the junior high school can do much to help its pupils recognize their roles in this culture.

For many years the junior high school has prided itself on its value as an exploratory institution, especially in such fields as music, art, shop,

Donald W. Lentz is Principal of the Carrie Palmer Weber Junior High School in Port Washington, New York.

home economics, business education, and foreign languages. Meanwhile we have not taken advantage of the exploratory opportunity in the so-called academic or "major" subjects, such as English, mathematics, and social studies. We have taken their content and importance for granted and have expected the pupils to study them as long as *required*. On the other hand, the exploratory "minors" were expected to be presented in an imaginative and interesting manner, to whet the appetites of the young and to sample and test their interests and potentialities in these areas.

Why not think of mathematics and other subjects in terms of exploration as well as achievement and sequential development? Why not seek to discover latent interest and potential there as in music? Why not provide a means that allows a pupil to operate effectively and with respect within his limitations as we might in art? This implies a need for evaluation of pupils as they enter junior high school and for preparation and presentation of materials as they move through the program.

As junior high-school administrators, we are responsible for maintaining a well-balanced program. At the same time there is a responsibility to have each offering, including mathematics, assume its proper, well-lighted place in the line-up of contestants seeking the interest of pupils. Much is being done, as the following statements of administrative and curricular problems and activity indicate.

Grade Seven, Inspirational or Expirational?

This grade usually includes pupils coming from several sixth-grade classes, often from several schools. Quite often they come with different preparations. This implies that the junior high-school administrators and teachers should examine carefully the mathematics preparation and potential of each pupil and plan a program accordingly. *Start where they are!* Standardized tests, class records, general intelligence, and many other factors can be used to learn the starting point.

Many schools are grouping seventh-grade pupils according to mathematical ability for mathematics and according to reading ability for other areas. This helps the many pupils whose capabilities differ significantly in the two areas. It requires a more complex scheduling system, but frequently pays dividends in terms of pupil growth.

Quite often this grade is used only to consolidate the gains made in grades one through six and results in a dull repetition of earlier work, especially for brighter pupils. Start where they are, of course, *but don't stay there!* Actually, pupils entering this grade are ready and eager for new experiences—often in a new school—and they soon become disillusioned and bored if these new experiences are not forthcoming. It is here that the teacher should recognize the importance of interesting pupils in the wonders of mathematics and inspiring them to follow the subject as far as their potentialities permit. Geometric concepts, fascinating ideas about number systems, new symbols, and many other mathematical ideas are being used by the imaginative teacher.

Grade Eight, Social or Mathematical?

The organization and course of study of eighth-grade mathematics are undergoing considerable examination and criticism at this time. In the attempt to "socialize" mathematics before the mid-century, topics such as bank services, budgets, insurance, taxation, and investment in stocks and bonds were given much time and space in the program. It was considered that these were things everyone should know, and it was recognized at that time that a relatively few persons would study the arithmetic and social significance of these items after grade eight.

Granting the value of knowing about these matters and being able to function quantitatively with them, there appear to be at least two major criticisms. *First*, many of the programs are so designed as to emphasize only the social aspects without developing the arithmetic concepts necessary for understanding the quantitative aspects. *Second*, most of the programs are about things (certain aspects of insurance and investment, for instance) that are too remote from the average child in the eighth grade.

An attempt is now being made to consolidate topics, eliminate non-essentials, and make the offerings more realistic in terms of the maturity of the pupils. Appropriate topics are being shifted into social studies or are omitted because of duplications in social studies and general science.

The time saved in streamlining the "social" part of grade eight is being used to develop other mathematical areas. In some schools, more attention is given to simple geometry and the development of elementary spacial concepts. Others are devoting more time to ideas associated with generalizations about numbers, equations, and mathematical symbolism. Specific introductions to algebraic and trigonometric ideas are becoming more common. Still others have compressed the usual eighth-grade program into a half year and have started the formal algebra course during the second half-year.

These modifications in the eighth year imply some kind of scheduling of pupils according to ability, interest, and need, with close cooperation among pupils, mathematics teachers, and whatever guidance personnel are available. The possibility of two and three tracks becomes greater as the program includes courses that are terminal, courses that are remedial or "improvement" in nature for those needing mathematical strengthening before proceeding, and courses definitely launching a higher mathematics program.

Grade Nine, Terminal or Preparatory?

Until quite recently, the offerings in most schools in the ninth year included elementary algebra for the more apt pupil and "general mathematics" for the less apt. In far too many situations, the general mathematics course was not well developed and was used for *all* pupils who, it was felt, could not succeed in algebra. It resulted in the bringing to-

gether of pupils with a hodge-podge of needs and abilities, and the teacher was faced with difficult or near-unsolvable course-of-study problems. For example, these classes often consisted of the very low ability pupil who always found it difficult to handle academic work, the pupil of greater ability who sought a terminal course in mathematics, and the apt pupil who needed strengthening of basic concepts before going into higher mathematics.

More and more schools are now considering the offering of several courses, including algebra, a general mathematics designed to prepare able pupils for higher mathematics, and a "remedial" and/or terminal mathematics. The courses may bear different titles, but essentially they are designed within a given school to meet the greatly varying needs and abilities of its pupils.

The ninth grade (and consequently the eighth grade and even the seventh) feels the pressure from demands for better mathematics training of the higher ability student. As a result, many schools are moving at least part of elementary algebra into the eighth grade and introducing or completing intermediate algebra or plane geometry by the end of grade nine. In grade nine it is especially important that mathematics teachers and guidance personnel work closely with the pupil to make as wise a choice as possible in view of available facts about the pupil.

"Modern Mathematics"—Is It for the Junior High School?

The recently introduced ideas of "modern mathematics" most certainly will have an impact on the junior high-school program. The new approaches to mathematical thinking, while being discussed primarily for the high-school level at this time, must eventually find their roots in the lower grades.

Mathematics teachers in our junior high schools should be encouraged to examine the thoughts proposed by leaders in this new field, such as Dr. Howard Fehr and Dr. Myron Rosskopf of Teachers College, Columbia University; Dr. Albert E. Meder, Jr. of Rutgers University; and Dr. Max Beberman of the University of Illinois. Special attention should be paid to the experiments of Beberman and to the University of Maryland Junior High School Mathematics Project under the direction of Dr. John Mayor.

The Maryland project, assisted by the National Science Foundation Institute, deals directly with the introduction of many of the new ideas into the junior high school. The experiment is being conducted in some 25 schools in the Greater Washington area, and has resulted in the preparation of materials for a tentative seventh-grade course.

Program Improvement—By Accident or Experiment?

Meeting the demands of this fluid, changing junior high-school mathematics is a joint responsibility of the administrators and mathematics teachers. Older teachers may need support as they move away from

tradition. Younger teachers may need direction and reassurance to teach things new in their experience. The administrator cannot usually serve as the subject-matter expert here. But he can make it possible for the experts—the classroom teachers—to keep abreast of developments in the field. After all, the quality of the mathematics program stems directly from the classroom teacher.

Encourage teachers to experiment and to prepare themselves and their pupils to meet new mathematical demands. As principals, help to develop an experimental atmosphere and to implement ideas resulting from sound evaluation. Encourage careful planning of experiments and eliminate the usual "cut and paste" re-shuffling of present topics. Encourage objective evaluation and minimize subjective analysis. Where possible, encourage formal study and sponsor workshops under competent leadership.

Encourage teachers to learn about progress in mathematics by joining *and participating in* their professional organizations. In addition to the local and state associations, the Central Association of Science and Mathematics Teachers and the National Council of Teachers of Mathematics have much to offer. Above all, encourage teachers to remain aware of the needs of *all* of the pupils. The gifted pupil has been neglected often, in the past. However, in the enthusiasm to remedy this defect, don't short-change the less able.

Chapter III

Students Talented in Mathematics

Mathematics and the Gifted Student—Some Problem Areas

A. HARRY PASSOW
and DETON J. BROOKS, JR.

IT WAS inevitable that the concern for identifying and educating gifted students, which had grown steadily for more than a decade, would mushroom with the first satellite launchings. Signalling a new age for mankind as well as another stage in the cold war, Sputniks opened the floodgates of criticisms. As the torrents poured forth, their main targets were the quality of programs and size of enrollments in mathematics and science. Many Americans assumed that Sputnik's having orbited before Explorer (and even Vanguard!) revealed the need for drastic revisions in school programs. Many were the proposals for "catching up." The essence of some of the suggestions was captured in a cartoon depicting a congressman rushing into a laboratory demanding "some instant science." No areas have received as much attention in the current reappraisals of education as have mathematics and the sciences.

There are serious inadequacies in mathematical provisions for gifted students but these shortcomings cannot be corrected simply by tightening requirements, eliminating electives, adding a new course or two, or increasing the portion of the total curriculum devoted to science and mathematics. Instead of exhortation, public accusation, and numbers games designed to show shortages, our nation needs careful analyses of the issues and problems involved in providing appropriate education for the gifted together with study of the factors affecting educational quality.

The problem areas in providing appropriate mathematics for the gifted are many. Real problems must be separated from the spurious ones. Nobody would debate, for example, the need for good elementary and secondary mathematics programs for the gifted. The first hurdle, however, is in recognizing the talented. Unless the gifted are identified and immersed in rich experiences, there is a danger that they will not develop positive attitudes toward mathematics or acquire the insights, skills, and

A. Harry Passow is an Associate Professor of Education, Teachers College, Columbia University, and Director of the Talented Youth Project of the Horace Mann-Lincoln Institute of School Experimentation; and Deton J. Brooks, Jr. is a Research Assistant with the Talented Youth Project, both of New York 27, New York.

understandings essential for higher specialization. These critical times call for an ever increasing number and variety of talented persons—individuals with the endowment, motivation, education, vision, and values to meet the nation's need for trained specialists and leaders. What, then, are some of the questions troubling persons responsible for developing better mathematics programs and general education programs for the gifted? What are some of the problems faced?

Can the gifted in mathematics be identified adequately? In general, the techniques and instruments used in identifying the intellectually gifted seem equally applicable for identifying students with potential in mathematics. Whether there is a special ability, or complex of abilities, or simply a channeling of high intelligence into mathematics learnings, has not been clearly established. Certainly high intelligence alone does not guarantee unusual success in mathematics. By using procedures for determining intelligence, interests, special aptitudes, and achievement, students who require and can profit from special programs can be located. The traits and characteristics, which are attributed to students demonstrating outstanding success in mathematics and science, are essentially those which describe groups of intellectually gifted students: extraordinary powers of concentration and persistent efforts devoted to a given task, excellent memory, highly exploratory and inquisitive minds, unusual ability to handle abstract concepts and ideas, originality, *etc.*[1] As Super and Bachrach point out, "the good student of mathematics, the mathematics major, and the mathematician emerge from the scant literature as persons of superior intelligence and of superior achievement in school and college."[2]

How much mathematics for the gifted student? In the literature decrying shortages in science and engineering, the word most frequently used is probably *more* and the adjective is applied quantitatively rather than qualitatively. The question, "How much mathematics?" must be examined in terms of the nature of mathematics to be offered and the relationship of this area of learning to the total curriculum of the gifted student. The particular role of the secondary school in developing mathematical competency needs clarification in terms of its own educational level.

Mathematics, graphically described by Fehr as "both queen and servant of the sciences,"[3] has played a significant role in the preservation and development of civilization. The pivotal place of mathematics has been

---

[1]See, for example: M. H. Ahrendt, "Education of the Mathematically Gifted," *Phi Delta Kappan*, 34:285-7, April 1953. Howard F. Fehr, "Mathematics for the Gifted," *Bulletin of the National Association of Secondary-School Principals*, 38:103-110, May 1954. Kenneth E. Brown and Philip G. Johnson, *Education for the Talented in Mathematics and Science* (Washington: U.S. Government Printing Office, 1952. Pp. 3-6.).

[2]Donald E. Super and Paul B. Bachrach, *Scientific Careers and Vocational Development Theory* (New York: Bureau of Publications, Teachers College, Columbia University, 1957. P. 53.).

[3]Howard F. Fehr, "Communication of Scientific Thought," *Teachers College Record*, 57:86, November 1955.

dramatically documented in many sources.[4] However, no cultural history alone can adequately point up the central place of mathematics among the disciplines so crucial in a scientific-technical society. Literacy in mathematics, it has been pointed out, is as important now as literacy in the mother tongue and "a command of numbers can be just as important as a command of words."[5] Understanding of the basic concepts and processes of mathematics is an essential part of general education, especially for the gifted who have greater potential for acquiring and applying such insights.

It is important to disassociate the idea that all gifted youth need a sound foundation in mathematics from the notion that all gifted youth must specialize in mathematics and science. Educators should guage the minimum concepts and skills of mathematics which belong in the general education of any intellectually talented student, regardless of his specific aptitude or interest in mathematics or related fields. More and more areas of specialized talent require a substantial amount of mathematical knowledge for effective functioning. The gifted student must be at home enough with mathematics to insure reasonable literacy and competency in whatever area of specialized talent he eventually chooses. To deprive the gifted student of facility and competency in mathematics is to curtail his ability to communicate effectively with his intellectual peers. Therefor, the gifted student—regardless of whether he is to become a mathematician, scientist, engineer, or technician—should be more familiar with mathematics than the average student.

The task of the secondary school is not to graduate finished mathematicians and scientists, but rather to instill the raw materials which will then be fashioned and polished through specialization and advanced training at higher levels. It is for the schools to fan the flames of interest and motivation so that students will see and want to enter those areas of specialization requiring their unique talents.

The question, "How much?" is frequently answered in terms of years or units. An NEA-sponsored conference, for example, recommended that "all talented students should have at least three years of mathematics, including beginning and intermediate algebra, plane and solid geometry, and trigonometry. . . . Students with marked ability require four or five years of mathematics."[6] Other groups have prescribed mathematics throughout the secondary-school program, regardless of the nature of special interests or aptitudes of the gifted. Such proposals assume that basic competencies are attained only through such intensive study.

---

[4]See, for example: James R. Newman, editor, *The World of Mathematics* (New York: Simon and Schuster, 1956. 2535 pp.). P. B. Wiener and A. Noland, editors, *Roots of Scientific Thought: A Cultural Perspective* (New York: Basic Books, 1957. 677 pp.).

[5]H. S. Dyer; R. Kalin; and F. M. Lord, *Problems in Mathematical Education* (Princeton, N.J.: Educational Testing Service, 1956. P. 26.).

[6]National Education Association, *Finding and Educating the Academically Talented Student in the Secondary School* (Washington: the Association, 1958. P. 11.).

The question of balance is not easily resolved. If gifted students are sated with mathematics rather than having other kinds of experiences, there is a danger that narrow specialists will emerge or that motivation for advanced training will be throttled. It is essential to determine and preserve a balance in education among the sciences, the social sciences, and the humanities. "Each has a vital part to play and any policy which fails to nourish and strengthen all is shortsighted indeed," a Rockefeller report noted.[7] The amount of mathematics which should be provided is dependent, therefore, on the time that the school must set aside to achieve objectives both in this area and in the others.

While generally speaking there appear to be no sex differences in distribution of ability, there are significant differences in the study of mathematics and science: boys receive far more preparation than girls in these areas. In a 1954 study, boys made up 60 per cent of the plane geometry-intermediate algebra enrollments and 80 per cent of the trigonometry-solid geometry enrollments even though their numbers were approximately equal in the elementary mathematics courses in high school.[8] These differences are probably due to motivational and cultural patterns which affect the selection and guidance of students into the mathematics and science courses. Certainly such differences should be carefully appraised in terms of optimum programs for gifted students.

What should be the nature of mathematics for the gifted? The kind of mathematics gifted students will study is, of course, a prime consideration in answering the question of "How much?" If some of the current critics are correct, it may be that students are wasting time taking mathematics that is outdated and meaningless. One group states, "the traditional secondary-school program in mathematics . . . consists almost entirely of mathematics developed over 300 years ago, gradually introduced into schools over the past 150 years and crystallized into essentially present form approximately 60 years ago."[9] Fehr describes present programs as outmoded, stating that the mathematics curriculum "is oriented to nineteenth-century mathematics and physics, and no longer provides for present or anticipated needs of high-school students."[10]

What has come to be called "modern mathematics" represents both new subject matter as well as new organization, although the substance derives from traditional content.[11] The emphasis has come to rest on concept formation, on abstractions, on the acquisition of complex insights and skills. This emphasis obviously has particular applicability to the

[7]Rockefeller Brothers Fund, *The Pursuit of Excellence: Education and the Future of America* (Garden City, N.Y.: Doubleday and Co., 1958. P. 28.).

[8]National Manpower Council, *Womanpower* (New York: Columbia University Press, 1957. Pp. 178-9.).

[9]Commission on Mathematics of the College Entrance Examination Board, *Modernizing the Mathematics Curriculum* (New York: the Board, 1958. P. 2.).

[10]Howard F. Fehr, "The Mathematics Curriculum for the High School of the Future," *Teachers College Record*, 59:258, February 1958.

[11]National Council of Teachers of Mathematics, *Insights Into Modern Mathematics* (Washington: the Council, 1957. 440 pp.).

gifted. The University of Illinois Committee on School Mathematics and the College Entrance Examination Board's Commission on Mathematics are just two of the groups currently developing materials in which modern concepts are integrated. The former have prepared units for a four-year high-school mathematics program and the latter has issued several bulletins including one for an experimental course on statistics.[12] A curriculum for the future has been outlined by Fehr,[13] while modern mathematics is the focus of a bulletin issued by the National Council of Teachers of Mathematics.[14] In connection with its Advanced Placement Program, the College Entrance Examination Board has outlined a one-year twelfth-grade course in calculus and related analytic geometry.[15]

Any consideration of the nature of appropriate mathematics for the gifted requires attention to the perennial problems of articulation and integration. For example, in order to take mathematics for advanced placement in the twelfth grade, the student must have completed the usual secondary program either by starting algebra in the eighth grade, taking courses at a faster rate, devoting more time to mathematics in grades nine to eleven, taking courses in which the content has been reorganized, or by combining some of these methods.[16] Changes at one point in the curriculum affects the rest of the program and close liaison is necessary between planners at all levels—elementary, secondary, and college—if continuity and integration are to be provided for. As secondary-school mathematics becomes more abstract in nature, changes will be required in the elementary program to provide necessary skill and concept building.

What kinds of special provisions should be made for the gifted student in mathematics? The literature on education of the gifted suggests that special opportunities may be provided within the classroom or that special grouping or acceleration may facilitate appropriate experiences or that some combination of these procedures may be used. There are many different techniques and procedures for enriching, grouping, and accelerating. Each has its advantages and disadvantages in terms of specific objectives.[17] A number of surveys of the methods used for providing for outstanding students in mathematics have been made over the past few years and each reveals that the variety of means being used are essentially the same as those described in the general literature on the

[12]UICSM Staff, *The University of Illinois Mathematics Program* (Urbana, Ill.: the Committee, June 1957. 11 pp. Mimeographed). Commission on Mathematics, *Introductory Probability and Statistical Inference for Secondary Schools: An Experimental Course* (New York: College Entrance Examination Board, 1957. 208 pp.).

[13]Howard F. Fehr, *op. cit.*, pp. 261-266.

[14]E. P. Vance, editor, *Program Provisions for the Mathematically Gifted Student in the Secondary School* (Washington: National Council of Teachers of Mathematics, 1957. 28 pp.).

[15]College Entrance Examination Board, *Advanced Placement Program* (New York: the Board, 1958. Pp. 106-116.).

[16]*Ibid.*, p. 106.

[17]For a discussion of the advantages and disadvantages of various administrative adaptations, see: A. Harry Passow, *et. al.*, *Planning for Talented Youth: Considerations for Public Schools* (New York: Bureau of Publications, Teachers College, Columbia University, 1955. Pp. 34-50.).

gifted.[18] There are no inherent undesirable consequences in any of the modifications designed to facilitate individualizing instruction and providing more adequate experiences. Such adaptations are means toward desired ends, seldom ends in themselves. The kinds of modifications needed in a particular school for the development of more adequate mathematics experiences for gifted students will be determined by the size of school, nature of professional staff, community setting, and similar factors.[19]

Who should teach the gifted mathematics? The key to the quality of education is, of course, the teacher since it is he who creates the environment for learning, provides essential guidance, and influences attitudes and career choices. How, then, can a school system find and hold competent, mature, well-prepared, insightful, and inspiring teachers? In addition to the economic and physical factors influencing quality of teachers, a response is demanded at both the pre- and in-service levels. The rapidity with which mathematics continues to develop and its yield of new insights should direct teachers to keep abreast of progress by constant study, visitation, and exploitation of personal and material resources. The National Science Foundation[20] sponsored 87 institutes for some 5,000 high-school teachers of mathematics and science during the summer of 1957. These summer institutes are now being supplemented by academic-year and in-service institutes as well. Colleges, state departments of education, professional associations are all beginning to provide necessary assistance for teachers to extend their insights and understanding in modern mathematics. In its recent yearbook, the National Council of Teachers of Mathematics voiced the hope that professionals could shorten the "lag between creation and application and . . . aid the development of a secondary-school mathematics program reflecting twentieth century mathematics. . . ."[21] Specialists from industry and government in various areas of mathematics and science are being called into schools to acquaint both teachers and students with recent developments in their fields.

Some other problem areas. There are other issues which need to be examined in planning mathematics programs for the gifted. What is appropriate guidance for the gifted? With the current manpower concerns in engineering, science, and research, some persons would have the

[18]Garford G. Gordon, *Providing for Outstanding Science and Mathematics Students* (Los Angeles: University of Southern California Press, 1955. 111 pp.). Earl McWilliams and Kenneth E. Brown, *The Superior Pupil in Junior High School Mathematics* (Washington: U.S. Government Printing Office, 1955. 57 pp.). U.S. Office of Education, *Teaching Rapid and Slow Learners in High Schools* (Washington: U.S. Government Printing Office, 1954. Pp. 38-43.). Thomas J. Frain, *Administrative and Instructional Provisions for Rapid and Slow Learners in Catholic Secondary Schools* (Washington: Catholic University of America Press, 1956. Pp. 85-93.).

[19]R. J. Havighurst; E. Stivers; R. F. DeHaan, *A Survey of the Education of Gifted Children* (Chicago: University of Chicago Press, 1955. P. 29.).

[20]National Science Foundation, *Seventh Annual Report, 1957* (Washington: U.S. Government Printing Office, 1958. Pp. 71-72.).

[21]National Council of Teachers of Mathematics, *Insights into Modern Mathematics, op. cit.*, p. 426.

schools channel all outstanding students into the areas of mathematics and science, the better to replenish shortages.[22] Fortunately, the growing body of research on the making of scientists remind curriculum planners of the need for other characteristics in addition to high intelligence as prerequisites for success.[23] Our country needs and can stimulate many varied talents, and no one specialized area in a democratic society can or should try to secure all those with high ability. With the pressures for scholarships and college admissions tempting students in mathematics and sciences and with campaigns of many kinds appealing for engineers and scientists, it is too easy to overlook the function of the school in providing "models" for the student, in making available rich and satisfying experiences, in developing understanding. While research studies do not point to any particular sequence or combination of courses as having induced more students to enter science and mathematics, they do underscore again and again the significant role of the inspired teacher.

The challenge to the secondary-school principal is to meet the crisis by providing sound educational leadership for his faculty and community. Instead of blanket whitewash or condemnation, instead of hasty program patching, instead of improvisation, the principal can help the staff to examine the local problems which prevent the community from developing a good mathematics program for the gifted. Mathematics is not the whole of secondary-school education for the gifted, but it is an important component. A way must be found to blend the insights of the mathematician with the understanding of the mathematics educator so that classroom teachers can acquire the knowledge, attitudes, and skills for identifying and nourishing potential talent. Through opening channels for maximum self-realization for each individual, a free society will meet its talent needs.

[22] See, for example: Kermit Lansner, editor, *Second-Rate Brains* (New York: Doubleday and Company, 1958. 96 pp.).

[23] Charles C. Cole, Jr., *Encouraging Scientific Talent* (Princeton, N.J.: College Entrance Examination Board, 1956. 259 pp.). Paul F. Brandwein, *The Gifted Child as Future Scientist* (New York: Harcourt, Brace and Co., 1955. 107 pp.). Anne Roe, *The Making of a Scientist* (New York: Dodd, Mead and Company, 1952-53. 244 pp.). Donald F. Super and Paul B. Bachrach, *op. cit.*

Gifted Students in Senior High School Mathematics

FRANCES FREESE

THERE are two principal methods of dealing with students gifted in mathematics. One is by working with superior homogeneous groups and the other is by working with gifted students individually in regular non-segregated groups.

Frances Freese, W. H. Adamson High School, Dallas, Texas.

If the school and the community are ready for dividing the students into homogeneous groups, the problem resolves itself into implementing the program at all levels. One plan is to start algebra with a select group in the eighth grade and to complete an enriched high-school course in the eleventh grade so that, in the last year of high school, the superior students may take a college course which will prepare them for advanced standing examinations. The same results may be obtained by completing four courses of enriched college preparatory mathematics in three years, so that the last year may be free for the course in college mathematics.

The students selected for this program should have high scholastic records in all subjects and superior reading ability so that the addition of an extra subject to the regular academic load will present no problem. With the present division of courses, it is a simple matter for the student to take two courses in mathematics concurrently at any time after he has completed first-year algebra. In some instances this "doubling in mathematics" may be reduced to one semester if students are permitted to study solid geometry individually during the summer. This pre-supposes a well-organized course of study with appropriate assignments and an examination at the beginning of the fall semester.

While, admittedly, high mathematical aptitude is a necessary criterion for admission to special classes in mathematics, it is, by no means, a sufficient criterion. Proven industry, achievement, and motivation are factors to be taken into consideration. Therefore, provision should be made for admitting to these classes at any time those students who show achievement and motivation sufficient to justify the change. Furthermore, it should be possible to drop from these selected groups those students whose progress is unsatisfactory.

The teacher of gifted students in regular classes faces a challenge and a responsibility as great or greater than does the teacher of the homogeneous high-aptitude group. A modified contract program is a convenient arrangement for caring for individual differences in this situation. It permits the student to work at his own rate and on his own level of difficulty. It provides for those students of similar activities to work together on occasions. It gives the superior student the opportunity to explain the work to others. The teacher must know the individual weaknesses and varying interests of his students so that he may suggest appropriate reading and study materials when required contracts are completed.

A conveniently located workroom to serve as a mathematics library and laboratory is most desirable. It will serve for group discussions, club meetings, and as a place for extra study for students from the regular study halls. If such space is not available, interesting and challenging materials in the classroom itself can be used to good advantage.

An honor mathematics club can serve as a stimulus to research and also to creative work. It should provide for free exchange of ideas, reports

on new or novel approaches to mathematical concepts as well as group discussion of current advances in mathematical thought. It may well serve as a testing ground for papers to present at the Junior Academy of Science's fall program.

Individual, school, and city libraries are often woefully inadequate to the needs of the student interested in modern concepts in mathematics. This problem can be met in various ways. The mathematics faculty may pool their own books on the subject or, if aware of the need, the PTA or Dad's Club will no doubt be glad to help. Nearby colleges will usually be found most cooperative.

For the extremely gifted student in mathematics, the nearby or local colleges will cooperate in every way to help with his development. One excellent college, for example, admitted a student to regular classes at the end of his junior year. Another university has arranged for a high-school student to take differential equations three times per week—the other students do not know that one member of the class is a high-school student, but they have remarked that he is better prepared for the work than they are. Most of us have not tapped the community resources—certainly there are men and women near who would be glad to help the unusual student.

Almost all colleges give advanced standing examinations or recognize the results of the Advanced Standing Examination of the College Entrance Examination Board.

For the last two summers, fifty students from Texas high schools have had the unusual opportunity of participating in five-week courses for gifted students in mathematics. (This program is described later in this chapter in an article written by Don Edmonson.) The students were selected from applicants from the top one per cent of our students. They have had excellent records in all subjects with emphasis on mathematics, English, and foreign languages. Almost all of the students selected were student leaders who participated in many and varied activities. The students who have participated in these excellent programs return to share enthusiasm and new ideas with their classmates.

Recognition of these gifted students is important. They are making a contribution to the school and its program just as the athlete, the public speaker, or the musician is. Their influence raises the level of the work of other students. An honors-day program; public announcement of awards; mathematics honor club seals on diplomas; recognition on diploma of participation in honors program for one, two, or three years; and announcement of participation and results in contests are several means of showing deserved recognition.

The success of any program that will meet the current needs of students gifted in mathematics will depend to a large degree on the selection of teachers. Certainly a minimum requirement is a major in mathematics. This is by no means a sufficient requirement since the college graduate of

ten years ago, even with a major in mathematics, may have scant knowledge of recent developments, modern trends, and current usage in the field of mathematics. Fortunately the teacher who has the courage to examine critically his knowledge or lack of knowledge of modern mathematics can bring his mathematics education up to date by studying material easily available. Especially recommended are: *The Mathematics Teacher;* the December 1958 issue of this publication, THE BULLETIN; the publications of the Commission on Mathematics of the College Entrance Examination Board; the Advanced Placement Program of the College Entrance Examination Board. The last two can be secured by writing to the Executive Director of the Commission on Mathematics, College Entrance Examination Board, 425 West 117 Street, New York 27, New York.

Even recent graduates can profit by excellent current books on symbolic logic, number theory, sets and functions, as well as modern texts in algebra, geometry, and trigonometry. The most important admonition to teachers and administrators is that we accept our challenge, our privilege, and our responsibility in our work with the students gifted in mathematics.

The Rice Institute Summer Program for Talented High School Students

L. K. DURST

IN THE summer of 1957, The Rice Institute offered a five-week course designed to stimulate the interests of superior high-school students in mathematics. This course was one of five similar courses in Texas sponsored by a grant from the Fund for the Advancement of Education. Dr. Robert E. Eakin, Research Professor of Biochemistry of the University of Texas, acted as coordinator for the five projects. Two of these five courses were in mathematics (Rice Institute and Southern Methodist University); the others were in biology (Texas A & M College), chemistry (University of Texas), and physics (Texas Technological College).

Announcements were sent to each accredited high school in the state describing the program and requesting the nomination of superior students. To qualify for nomination, a student was expected to stand among the highest one per cent of high-school students in the state, to have completed at least one year of algebra and one year of geometry with excellent grades, and to have at least one year of high-school work to complete before graduation. Over 160 students were nominated for the twenty-five places in the course at The Rice Institute. The class consisted

L. K. Durst is Assistant Professor of Mathematics, The Rice Institute, Houston, Texas.

of nineteen boys (two sophomores, seventeen juniors), and six girls (all juniors).

In the spring of 1957, the Institute had inaugurated its Residential College System. Since there are no summer sessions at Rice, the members of the summer program were able to reside together in one of the colleges, taking meals in the college dining hall. In addition to the students, Mr. Horace Flatt, the assistant instructor; Mr. Durst, the instructor in charge; and Mrs. Durst stayed in the college. This arrangement was found to have many advantages; there was ample opportunity for social contact and informal discussion of mathematical and other matters.

Class work was divided into four main parts: regular lectures, discussion of problems, exposition by the students, and special lectures by members of the Institute faculty representing the several sciences. The class also spent one afternoon as guests of the electronic computer section of a local oil company's research laboratory.

The regular lecture series covered a variety of topics from logic, geometry, algebra, and analysis. Considerable emphasis was placed on formal reasoning: approximately two of the five weeks were devoted to symbolic logic (statements, properties, relations, functions, and quantifiers). With this foundation, it was possible to discuss several postulational systems, including finite and non-euclidean geometries, and to give an introduction to the theory of ordered fields with special emphasis on the field of rational numbers. The step from the rational field to the real field was made by using Dedekind sections, following Hardy's *A Course of Pure Mathematics*. The final three days of the course were devoted to the properties of functions continuous on closed intervals (intermediate and extreme value theorems) and to calculus.

It will be noticed that there is very little in this syllabus to duplicate topics which the students would be expected to encounter in their high school or beginning college courses. It will also be noticed that considerable attention was devoted to logical rigor and the systematic development of a fragment of mathematics. These phenomena are by no means unrelated. In outlining this course, the Department of Mathematics of the Institute felt that it was necessary to include some significant portion of mathematics which should be treated in detail and with as much care as possible. The real numbers were selected as their properties are fundamental in any development of analysis. On the other hand, careful study of the real numbers is customarily omitted, leaving a large gap in the logical presentation of elementary calculus courses.

The student reports covered a wide variety of topics including (1) the Jordan curve theorem for polygons, (2) the coloring of maps, (3) Euclid's and special cases of Dirichlet's theorems of the infinitude of primes in arithmetic progressions, (4) network problems and the bridges of Koenigsberg, (5) Euler's formula and the regular polyhedra, (6) Pythagorean numbers and Fermat's last theorem, (7) perfect numbers

and Mersenne primes, (8) extremal problems and the isoperimetric inequality, (9) paradoxes and the logical antinomies. These reports were assigned to groups of two or three students who were given a week for preparation and half an hour of class time for the presentation of each report. There was also a series of five one-hour student reports: Linear algebra and systems of linear equations; polynomial equations of the second, third, and fourth degrees; probability; games of strategy; and groups, rings, fields.

In the opinion of the instructors, this experimental program was very much worth while. The students enjoyed working with other excellent students and seemed to thrive on their association with them. The nature of the subject matter and the amount of work accomplished in five weeks show that excellent students are capable of much more than the usual high-school program would indicate. On being asked to evaluate the course, students admitted that they were by no means overworked and could have done much more. Accordingly, when the course was repeated in the summer of 1958, Dr. Alan Wilson presented a series of lectures on topics from finite mathematics in parallel with the lectures on logic and analysis; the effect was to double the content of the course. The students in the 1958 course were kept busy; they even appear to have enjoyed their course more than the 1957 group.

The effects, and hence the value, of a project such as this cannot be determined for several years. Encouraging signs have begun to appear, however: some high-school students have been inspired to do better work in order to qualify for these courses, and, in general, better students have been induced to study topics beyond their ordinary course work. In a number of cases, the students returning from these courses have been interviewed by school authorities and teachers interested in exploring possible ways of strengthening local curricula. In the case of Houston, the school board financed a repetition of the 1958 Rice Institute course expressly for students in the local public high schools. The course for local students was given by the Institute in the latter part of the summer of 1958 immediately following the course open to students on a state-wide basis.

The JvN Memorial Mathematics Summer Seminar for Talented High School Students

DON E. EDMONDSON

THE JvN Memorial Mathematics Seminar is Southern Methodist University's part in a three-year experiment called the *Summer Program for Talented High-School Students* which is being conducted in the state of Texas. Dedicated to identifying and encouraging the gifted student, the experiment was conceived by the science faculty of the University of Texas—where the first pilot project was conducted in the summer of 1956. In 1957 and again in 1958, SMU with The Rice Institute, Texas A & M, and Texas Tech joined the University of Texas by extending the original project in chemistry into the fields of mathematics, biology, and physics, respectively. The projects manifest essentially the same flavor, though differing in course content and details of operation.

The specific purpose of the JvN Memorial Mathematics Seminar has been to provide select high-school senior students with an introduction to the wide scope of interesting ideas which now composes the field of mathematics—then informed, challenged, and with renewed horizons, to send them back to their high schools where others might gain from their experiences. Doing as much of this as possible in five weeks, the seminar has also sought to extend the students' knowledge in areas other than mathematics, particularly to clarify existing ideas about the various disciplines. And finally, the seminar has sought to render a service to the really brilliant students—to help them in their adjustment problems and to aid them in moving toward the full realization of their potential.

The machinery of the seminar has been two series of daily lesson material complemented by personal contacts, guest lecturers, field trips, and participation in two-man-team research projects. One lecture developed concepts in the area of symbolic logic, set theory, boolean algebra, and probability while the other introduced calculus, matrix algebra, modulo arithmetic, group theory, linear programing, and game theory. Regular homework was required with individual assistance available through supervised study periods. The lesson material was largely taken from three challenging books which were provided to the students. Guest speakers came each day representing many of the different fields of intellectual inquiry. Care was taken to select interesting and active people who could speak with authority and answer the questions from experience. Weekly field trips were made available by interested scientific installations in the community and provided firsthand information from scientific people at work.

Don E. Edmondson is Director of the JvN Memorial Mathematics Seminar, Department of Mathematics, Southern Methodist University, Dallas, Texas.

Each seminar has consisted of about twenty-five students carefully selected from the students in the top two per cent of their classes. The basis of selection was high-school record, intelligence test scores, interest, and the question. "Can we be pretty sure of doing something good for this particular student?" Only one student was taken from a high school and attention was given to the particular need in the small schools. Selection was done in each case by the seminar director.

The staff consisted of a university mathematician as director-lecturer, a high-school teacher as assistant director-lecturer, a mature student as general flunky. The seminar has been fortunate to have William K. McNabb of Hockaday School as assistant director. McNabb gave the logic sequence of lectures and provided steadying experience with, and insight in, the high-school student. The flunky graded papers and tests, gave a battery of tests, and was receiver of complaints.

The seminar was made possible by a grant from the *Fund for the Advancement of Education* which provided books, tuition, and expenses of the project. The students came because of interest, for no high-school or college credit was promised. For the seminar they were responsible for their travel, room, and board—all students lived in the dormitories. While on campus, the seminar participants were treated as ordinary students and had full access to all university facilities.

The seminar not only tried to provide stimulating academic experiences, but also felt a responsibility for the human side—in particular to make the students' introduction to college a memorable one. This was achieved in part through such devices as birthday cakes, a student newspaper, an occasional social event, a group picture, and a final banquet with speaker and diploma. It is probably too soon to evaluate accurately the experiment alongside of its ambitious objectives; however, it is felt that the seminar has served a good function in its state. And further, if it proves to have helped but a few to achieve their promise, then all the work and the dedication of The JvN Memorial Mathematics Seminar will not have been in vain.

The Seattle Project for Talented Students

ELIZABETH ROUDEBUSH

A PILOT study for able students in mathematics was set up in a Seattle junior high school in 1952. The object of the study was to determine the mathematics that able and ambitious students could master in junior high school when scheduled in a segregated class. It has been

Elizabeth Roudebush is Director of Mathematics in the Seattle Public Schools, 815 4th Avenue, North, Seattle 9, Washington.

found that the students in special classes can cover junior high-school arithmetic plus enrichment topics in grade seven and most of elementary algebra in grade eight. In grade nine these students can do a fine job with either plane geometry or intermediate algebra. The Seattle program now places the able ninth-grade students in intermediate algebra rather than in plane geometry. Such an arrangement meshes smoothly with the senior high-school mathematics program for able and ambitious students. In the course of the pilot study, some students in senior high school had an extra year of mathematics. The students covered solid geometry, some work in symbolic logic, and topics from college algebra.

Regular Senior High School Program

For many years the mathematics program in senior high school has been very strong. In grade ten, plane geometry is taught to about 65 per cent of the students. In grade eleven, students enroll in intermediate algebra the first semester and trigonometry the second semester. In the twelfth year, two semesters of mathematical analysis are offered. Although this course is not a course in calculus, differentiation and integration are presented early in the course and are used throughout the year. A college textbook is used for the course. For a few years, segregated classes have been formed for tenth-grade pupils who are able and ambitious in mathematics. In these classes both plane and solid geometry are presented.

The Six-Year Program for Able Students in Mathematics

Starting in September 1958, Seattle Public Schools are carrying out the following mathematics program for the able and ambitious student:

Grade Seven

Students will have thorough and challenging work in arithmetic from the regular seventh-grade textbook. Enrichment topics will be presented and students will be expected to undertake original study projects. When such a study is complete and the report prepared, it will be presented to the entire class. Some of the enrichment topics include number systems other than our decimal system, topics from the history of mathematics, construction of a slide rule, interesting applications of mathematics.

Grade Eight

Students will finish necessary work in arithmetic in about two months. Elementary algebra will be started and continue throughout the rest of the year. The students are expected to do the most difficult topics of elementary algebra. Discussions in class will emphasize meanings rather than techniques. Students are expected to work independently on daily assignments and to do original thinking in problem solving. Two or three topics in elementary algebra may be carried over to grade nine.

Grade Nine

Elementary algebra will be completed by the end of the second month. Intermediate algebra will then be introduced and completed by the end of the school year. Students will be expected to do the same fine work in intermediate algebra as in elementary algebra.

Grade Ten

Plane geometry will be covered in about 25 weeks so that there will be time to complete solid geometry by the end of the year. Some students in the special geometry classes will have been in the accelerated mathematics program of junior high school. Other able students will be included in the special geometry classes on the basis of superior work in regular algebra classes.

Grade Eleven

Students who studied intermediate algebra in the accelerated program in junior high school will be placed in special classes during the first semester. The mathematics taught during this semester will include topics recommended by the Commission on Mathematics of the College Entrance Examination Board. Probability and Statistical Inference would be one of the topics presented. Other topics of modern mathematics will be included. During the second semester the students will take the usual semester course in trigonometry.

Grade Twelve

The regular course in mathematical analysis is designed for able students. The content of the course will be in line with the recommendations of leaders in mathematical education throughout the country.

Selection of Students for Special Mathematics Classes

Principals in the secondary schools have an important responsibility in the selection of students for the accelerated mathematics classes. The manner of notification of the students and their parents is at the discretion of the principal of each school. The counseling staff of each junior and senior high school has an important role in helping the principal with this responsibility.

There are two broad criteria for the selection of students for the special classes in mathematics. First, we consider the results of standardized tests. Tests used are group intelligence tests, mathematics achievement tests, reading tests, science tests, and individual intelligence tests when available. Second, we consider teachers observations on aptitude for mathematics, ability for independent study, consistent high-level work, physical stamina and regular attendance, social and emotional maturity, relationship of age to grade. The relationship of chronological age to grade level must be considered constantly since a younger pupil may appear immature in comparison with an older one in the same grade, but actually be advanced intellectually and emotionally for his age.

Selection of Teachers

The mathematical background of the teacher should be broad and thorough. Ideally, the teacher of the able junior high-school students should have a major in mathematics and have had some exposure to the current thinking in content, language, and philosophy of modern mathematics. In addition to mathematical training, the teacher should have a few years of teaching experience in the mathematics subject he is to teach. The teacher should have well-above-average intelligence, a genuine desire to work with able students, a tolerance for new and different ideas, a

willingness to let students proceed on their own, and the ability to direct individual students toward maximum achievement. The secondary-school principals hold the key position in the selection of teachers for the special classes and in the guidance they give to these teachers.

Flexibility of the Program

The first selection of students for accelerated classes comes at the beginning of grade seven. At the beginning of grade eight, some students will be added to the accelerated class and some who have been in it the first year may be moved out of it if they have not been able to maintain the pace. At the beginning of grade ten, the special geometry class will be formed with students from the accelerated ninth-grade algebra classes and also with students from the regular ninth-grade algebra classes.

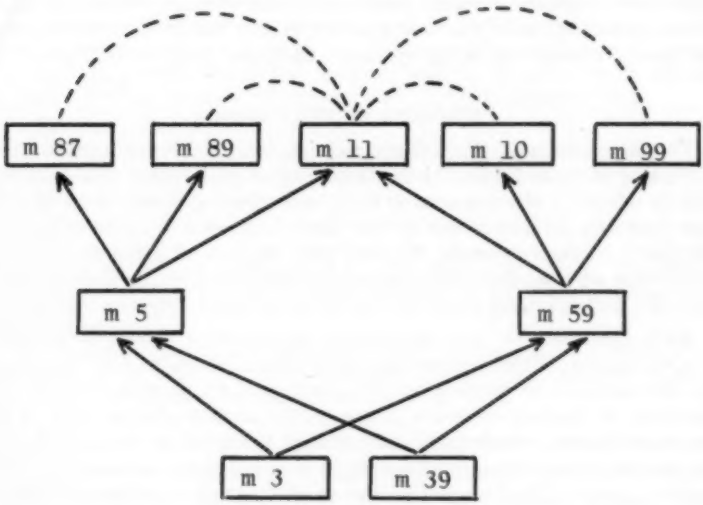
Each candidate for the accelerated mathematics classes is invited to join the group. However, no student is forced to come into the class if he does not wish to participate. The success of the project depends upon selection of students who are interested in mathematics as well as able learners. Superior students whose interests are in fields other than mathematics and science should not be urged to enroll in the accelerated mathematics classes. The teachers of the special classes, mathematics department heads, department chairmen, the director of mathematics, school principals, and counselors will work together to provide the best experience possible for the able and ambitious students enrolled in the accelerated mathematics program of Seattle Public Schools.

Mathematics at the Bronx High School of Science

IRVING ALLEN DODES

SOME four years ago, the Department of Mathematics requested that all departmental meetings be devoted to *mathematics*. The teachers set themselves the task of re-learning certain important old topics (symbolic logic, theory of sets, groups, and fields) and of learning the new topics (computer programming, linear programming). The purpose of this effort was to consider the introduction of some or all of this material in our mathematics offering. This we have done. After a great deal of study and work, the Department introduced into the twelfth-year mathematics courses all of this material. (see Chart I and Legend). These courses are taken by about 65 per cent of our seniors.

Irving Allen Dodes is Chairman of the Department of Mathematics, Bronx High School of Science, New York City.



Legend for Chart 1

m 3: *Tenth-Year Mathematics:* a New York State Regents course (enriched).

m 39: *Tenth-Year Mathematics* (Special): includes all of m 3, but approaches the subject through a study of symbolic logic and the theory of sets.

m 5: *Eleventh-Year Mathematics:* a New York State Regents course (enriched) which integrates intermediate algebra, trigonometry, and the elements of plane analytics.

m 59: *Eleventh-Year Mathematics* (Special): includes all of m 5, but approaches the subject through a study of symbolic logic, theory of sets, groups and fields, functions and relations.

m 87: *Twelfth-Year Mathematics:* The first half is an enriched version of the New York State Regents course in Advanced Algebra. The second half is a course in solid geometry with some vector analysis and solid analytics. Volumes are taken up through integration.

m 89: *Twelfth-Year Mathematics:* This is the New York State Experimental course which covers most of "Principles of Mathematics" by Allendoerfer and Oakley and includes a sizable unit on vector analysis and solid analytics.

m 11: *Mathematical Techniques in Science:* (co-requisite: m 87, or m 89, or m 99, or m 10). This is a course which includes a thorough preparation in such fields as "Programming for an Electronic Computer" and gives background in astronomy, navigation, theoretical physics, theoretical chemistry, and theoretical biology.

m 10: *Analytic Geometry and the Calculus:* (pre-requisite m 59). This is the Advanced Placement course which covers approximately the part of Thomas' *Analytic Geometry and the Calculus*, Wilson and Tracey's *Analytic Geometry*

and Allendoerfer and Oakley's *Principles of Mathematics* which are covered in the first three terms at Massachusetts Institute of Technology and the Polytechnic Institute of Brooklyn.

m 99: *Twelfth-Year Mathematics* (Special): (pre-requisite m 59). This includes all the material in m 87 and m 89, and, in addition, advanced material in abstract algebra, statistical inference, and programming.

The new material in the twelfth-year courses evoked very favorable responses from the students, the teachers, and even from the colleges to which the students went. As we expected, teachers who had taught this "pretty" mathematics tended to try it out in eleventh-year classes. It was first tried on a full scale in the *special eleventh-year classes* which included the best mathematics students in the junior year. Their enthusiastic response brought forth a popular demand for similar material in the regular classes. Almost all the eleventh-year classes now use the "modern" approach. ("Modern" means "less than 300 years old.")

Last year, we experimented with symbolic logic and set theory in four special tenth-year (geometry) classes. These classes were composed of entering students who appeared to be very superior in intellectual ability. It is too early to make as clear-cut a decision as we did in the eleventh- and twelfth-year classes, but there is no doubt that the classes understood and appreciated the new material. They definitely liked it better than the regular Euclidean geometry. As the news filters to the other tenth-year classes, requests pour into my office for transfer to these classes. It seems clear that the new approach will soon pervade all the geometry classes.

The Department is fairly well satisfied with the eleventh- and twelfth-year offerings for the present, but there are many problems in the tenth year. It is felt that a better course can be made if a more general switch is made from Euclid to Descrates. We are working on this now.

Almost all our students enter in the sophomore (tenth) year. Four classes are set aside for experimental work. We choose for these classes students who are unlikely to suffer by our errors. At the end of the tenth year, we accept applications for the special eleventh-year classes (m59). About 80 are taken. At the end of the eleventh year, applications are accepted from the m59 students for m10 or m99. Every special student goes into one or the other of these. As you can see, we differentiate the offering as much as we can to oblige the extremely gifted, the moderately gifted, and those who are interested, but not necessarily gifted.

The University of Maryland Project and Talented Students

M. L. KEEDY

THE University of Maryland Mathematics (junior high school) Project, made possible by a grant from the Carnegie Corporation of New York and directed by John R. Mayor, is now in the second of its three years. The study is concerned mainly with the development of courses with modernized mathematical content for grades seventh and eighth. The study is not concerned wholly, or even primarily, with the so-called "gifted" or "talented" student, but aims to find out how to modernize the curriculum for all students. The experimental seventh-grade course now being taught seems to be pitched at a level which aims at the slightly above average, yet it has a great deal more to offer the talented than the traditional courses of study.

"Talented" is of course a wide category and generally loosely defined. Although it is not appropriate here to discuss its proper definition, it will be convenient to subdivide the category. The "capable" (those who can and do learn quickly) will be distinguished from the "brilliant" (those who learn quickly and whose interest and drive is high). For either of these, the course lays a better mathematical foundation than traditional courses have done. Although the calculating skills are not neglected in the new course, they are not given the leading role. Rather, an understanding of structure of mathematics and an appreciation of its beauty come first in the hierarchy of emphases. There is no attempt to distinguish algebra from arithmetic. The student learns about numbers and their properties, whether or not he is using letters. Most of the fundamental principles of so-called algebra are introduced early as properties of numbers, and, throughout the course, these basic properties are emphasized and restudied as the student looks at patterns in various mathematical systems. In this way a great deal of the mystery of algebra disappears, and the fact that mathematics is man-made comes into focus. The distinction between mathematics and the physical world is clearly made. This is felt to be extremely important, not only for giving a true picture of the nature of today's mathematics, but also for opening the imagination and encouraging creativity.

In the new course certain new terminology has been introduced, and some familiar words have been given new meanings. This is to make linguistic precision possible. The student is to be taught to use language precisely in mathematical activity, since precision of language is the keystone of the subject. Therefore, it is mandatory to provide him with a

M. L. Keedy, University of Maryland Mathematics Project, University of Maryland, College Park, Maryland.

language which is adequate since it has been found that the traditional language of arithmetic and elementary algebra is not.

The two fundamental reasoning processes—induction and deduction—are built into the new course in a way that is not ordinary. The student is encouraged to guess and to play hunches, at the proper times, and his inductive conclusions are regarded as valuable. They are not regarded as final, however. The student is shown that he must reason deductively in order to establish many general principles. At this level the deduction is largely informal, there is no established pattern or stereotype for doing proofs, and the free imagination of pupils is encouraged by the teacher's accepting as valid any "proof" produced by a student, as long as it is deductive and without serious shortcoming. This feature probably carries the most profound import for the talented of the several mentioned. Using this method the teacher encourages creativity, by showing the student that his thoughts are worthy of consideration and by setting the stage for *his* discovery of important principles or interesting results. The implications of this feature reach a good deal further. They need not be elaborated here, but they involve the worth of the individual and his thoughts, and the development of a person as a useful and creative individual—items which are vitally important to our society.

It is not, of course, possible to construct a junior high-school mathematics course which provides well for students of all abilities without making many special provisions for individual differences. For the talented, the new course lays a good mathematical foundation, but library work, outside reading, and special guidance from the teacher are still as necessary as they ever were. The amount of outside work and teacher guidance required for the *capable* student should not be as great with the new course as with the traditional, since the mathematical content of the new course offers a greater challenge. For the *brilliant* student, however, the new course could very well increase the demands on the teacher. The content of the new course is such that it may serve mainly to whet the appetite of the brilliant, in which case the absence of extra guidance and reading material for him is more serious than before. Supplementary work for the brilliant might profitably be found outside the school. For example, a mathematician in a University or in industry might be found who would be willing to spend short periods with a brilliant student or two. This is especially important in case the teacher has a limited mathematical background, since the junior high-school student who is brilliant enough to do some research of a fairly mature nature, mathematically speaking, is not as rare as might be imagined.

In the last analysis, it is the teacher rather than a course that makes for successful education of the talented. By writing a course, the Maryland Project hopes to assist teachers, but it is well recognized that it is the talent and background of the teacher which is of primary importance. For teaching the talented—especially the brilliant—the mathematical background of the teacher can never be too broad or too deep.

Ohio State University Works with Talented High School Seniors

PAUL V. REICHELDERFER

DURING the academic year 1956-57, four seniors in the University High School were informally taking courses in the Department of Mathematics at the Ohio State University. The way in which this happened, the experiences of these students, and the subsequent plans of the Ohio State University for admitting high-school students into some of its courses are briefly described below.

While these four students were still in junior high school, their instructor in mathematics, Mr. Eugene P. Smith, observed their superior intellectual abilities, their over-all success in their school programs, and their interest in mathematics. He proceeded to stimulate this interest by bringing these students together as a subgroup of their class for special work in mathematics and by encouraging them to proceed to study mathematics as rapidly and as thoroughly as their time, interest, and enthusiasm would allow. On the other hand, he insisted that this special interest should not interfere with their normal growth and development as mature and well-rounded high-school students. Although each of these students has better than average ability, none is a genius and none is a social misfit.

As these students completed their junior year, they were studying topics in mathematics usually found in the first two years of college work. Their instructor contacted a colleague in the Department of Mathematics at the Ohio State University to explore the possibilities for these students to continue their study of mathematics and to plan for their transition to a university which might recognize the exceptional progress they had made. Working through the College of Arts and Sciences, the Department of Mathematics arranged to admit these students informally and experimentally to its classes during their senior year as high-school students. The fact that the University School is located on the campus of the Ohio State University and follows the same quarter system as the University facilitated this arrangement.

Before these students were admitted to university classes, each was required to take the *Ohio State Psychological* examination and the placement and proficiency examinations in mathematics. One student passed proficiency examinations in all of the freshman mathematics courses and was admitted to the sophomore calculus course. A second student passed proficiency examinations in college algebra and trigonometry and entered the course in analytic geometry and the calculus. The other two students were admitted to the course in college algebra.

Paul V. Reichelderfer, Department of Mathematics, Ohio State University, Columbus, Ohio.

The Department of Mathematics assigned these students to the classes of instructors who were willing and eager to have them. Except for this fact, these students received no special considerations in the university classes. They were held to the same standards, took the same examinations as the regular students. At the end of each quarter, the instructors completed questionnaires showing the standing of each student in his class, and his attitude toward and participation in that class. Detailed reports on the progress of each student were kept by the Department, copies of which were forwarded to the Dean of the College of Arts and Sciences and to the Director of the University School.

At the end of their senior year, all of these students took the Merit Scholarship examinations. Two of them won national honors; one of these received a five-year scholarship at Cornell University paying $1100 per year; the other received a "token scholarship" at Ohio State University of $100 per year. A third student was awarded an NROTC scholarship at Ohio State University, and the fourth accepted an appointment to the Academy at West Point. Each of the two students who formally entered Ohio State University last year was given college credit for the mathematics courses which he had passed either by proficiency or by regular examinations while he was a senior in high school.

Most of the persons aware of this experiment and its results—parents, high-school teachers, and counselors, university instructors, officials of both the high school and the university and, most important of all, the students were very enthusiastic; they felt that it was a step in the right direction toward meeting the challenge of providing better educational opportunities and incentives for gifted students. The University School requested that the experiment be continued and suggested that the university might wish to consider an extension of the program to subjects other than mathematics and to high schools near the university. Novice G. Fawcett, President of the Ohio State University, appointed a committee to study the matter carefully and to make recommendations to the university. This committee readily concluded that the university does not yet have enough experience in these matters to set up any permanent program, that the university has the responsibility to cooperate with the high schools in the state to aid them in improving the quality of their instruction, but that the ultimate responsibility for the education of high-school students resides in the high schools. It suggested that President Fawcett arrange a meeting between the superintendents and principals of the school systems near the University campus and members of the university administration and faculty to explore possibilities for our working together on this problem. As a result of the encouraging response generated by this meeting, the university has officially adopted the following experimental program through a memorandum to members of the university faculty and high-school staffs of school systems near the campus.

STUDENT ADMISSION METHODS

1. *Period of Authorization.* This program is to be followed during the Summer and Autumn Quarters 1958 and Winter and Spring Quarters 1959.

2. *Requests.* (a) A request for admission of a high-school student to a university course will be made in writing by the principal of the student's high school to the Chairman of the university committee, Assistant Dean W. T. Furniss, 108 University Hall, Ext. 103.

(b) The Chairman will forward the request to the department concerned for its approval or disapproval. If the request is disapproved, he will notify the principal. If it is approved, he will notify the principal, the student and the department chairman of its acceptance and of the following terms.

3. *Records and Follow-up.* (a) The Student will be enrolled *informally* in the course concerned. He will be expected to do the same work and take the same examinations as the regularly enrolled students.

(b) The Chairman will keep in the records office of the College of Arts and Sciences the following records: (1) correspondence relating to the student, (2) a record of the student's grade in the course, and (3) a report on the student solicited at the end of the course from the student's instructor.

(c) The Chairman will, upon receipt of the student's grade from the department, and of the instructor's report, forward these to the high-school principal.

4. *Admission to College:* credit for the course. (a) If the student is admitted to The Ohio State University, the department concerned in conjunction with the student's college will determine what credit will be granted for the work the student did in the course. Examination credit, waiver of requirement, or no credit may be granted.

(b) If the student enrolls in another college or university, at the request of the student, the Chairman will provide a statement to that college or university concerning the student's work and achievement in the course.

5. *Fees.* The student will not be required to pay fees for this work.

6. *Final Report.* In June of 1959 the Chairman will make a report to the President after consultation with his committee. The report will summarize the activities of the year under this program and will recommend continuance, modification, or abandonment of the program.

Meeting the Needs of Cincinnati's Gifted Pupils in Mathematics

MILDRED KIEFFER

THE point of view that exploration of many areas and interests rather than early specialization is sound for elementary children is set forth in two bulletins, *Challenging the Able Learner*, prepared by Cincinnati teachers and administrators for the primary and intermediate grades. In the area of mathematics, the program suggests that the able child should be stimulated to go as far as he can each year, and outlines an accelerated plan of study for him. Not only does he move through successive topics more rapidly, but he also deals with more complex cases and applications along the way. A record of the work he accomplishes, which is advanced for the grade, is available in the pupil's cumulative record folder.

The Mathematics Curriculum Bulletin recently completed by a committee of seventh- and eighth-grade teachers is based upon the assumption that extension of content is preferable to acceleration at this level. The emphasis is upon correct general concepts basic to future high-school and college work in mathematics. It is important to establish a sound elementary mathematics vocabulary and to strengthen computation skills to a high performance level.

Recommendations for able pupils include introducing and working with numeration systems with bases other than 10 in order to deepen understanding of the decimal system we use. Pupils learn about prime factors and consider conclusions which may be drawn about products, sums, and differences of even and odd numbers. They start to think in terms of collections or sets of numbers. The arithmetic of the clock face interests them. They devise special short cuts for computing mentally and speeding up their written work. The reason why an operation works is important to them. They use scientific notation in writing very large or very small numbers and speak of the significant figures in a result. Percentage is an application of ratio, and graphs employ line segments and areas to represent numbers. In their introduction to algebra, pupils realize the importance of inequalities as well as equations.

All comprehensive four-year high schools in Cincinnati offer the Advanced Placement Program in mathematics. Pupils begin in the tenth grade and follow an accelerated schedule which leads to the completion of the standard college preparatory mathematics sequence in the eleventh grade. In the twelfth grade, the pupils take a full year of college calculus. They take the CEEB Advanced Placement Examination in the spring and, on the basis of this examination, the colleges which they will enter in the fall determine the advanced placement and credit to be granted.

Mildred Kieffer is Supervisor of Mathematics in the Cincinnati Public Schools, Cincinnati, Ohio.

Pupils are invited to enter the tenth-grade class leading to Advanced Placement with the understanding that they will remain with the class throughout the three-year schedule. Family approval is necessary and parents are given information about the rigors of the course before they make their decision. A study of selection procedures led to the recommendation that certain test data be secured to aid in locating capable pupils. It is recognized that the amount of drive a pupil has, his interest in the subject, his intellectual curiosity, and his desire to go to college are among the important considerations in finding pupils who will probably succeed in Advanced Placement work. None of these is measured directly by any of the tests available.

Pupils who meet the following five criteria are eligible for consideration as possible candidates for Advanced Placement work.

1. Mental ability test—IQ 120 or above
2. Mathematics—PR 90 or above
3. First semester (9th grade)
   School grade-point average—3.5 or above in mathematics (4 points = A)
4. First semester (9th grade)
   Total grade-point average—3.0 or above in academic subjects
5. Teacher recommendation

In the tenth grade, these pupils, in classes of twenty-five to thirty-five, study standard college preparatory plane geometry, solid geometry, and second-year algebra to or including complex numbers. They study straight-line coordinate geometry, using its power to prove certain difficult theorems of synthetic plane geometry. A number of standard textbooks are used. Supplementary mimeographed materials are prepared by the teachers. In addition, pupils complete individual projects and assignments on such subjects as the nine-point circle, harmonic division, special constructions, golden section, angle division devices, fallacies, and non-Euclidean geometries. In the eleventh grade, pupils complete second-year algebra, analytics of conic sections, and trigonometry. The twelfth year is used for a complete course in calculus. In several classes the last few days of the year are given to pupil reports and discussions of topics on modern mathematics or advanced calculus.

Pupils have performed satisfactorily on the Advanced Placement Examination and have achieved well in advanced courses in college. In the minds of some teachers, there are still many reservations about such a highly accelerated program. They are aware of a constant feeling of pressure and anxiety about rapidly passing time. There is little opportunity for pupils to mull over ideas, to look at problems from a variety of viewpoints, or to pause to appreciate a particularly elegant proof. Teachers spend much time attempting to help pupils resolve the conflict between the heavy demands of the Advanced Placement Program for home study and the social activities traditionally regarded as the birthright of seniors.

Recently an Advanced Placement class was asked to make a critical evaluation of the program from the point of view of the pupils. They spoke of their satisfaction at being in a class with pupils truly interested in mathematics and recommended that everyone with the ability to do the work should try it. They mentioned the amount of study and preparation required and spoke of this as both a current challenge and excellent preparation for college. A strong recommendation was made for more time for class explanation and discussion and more time for independent thinking outside of class. Many pupils referred to the ever-present need for hurrying along to the next topic in order to be ready for the examination early in May. Pupils said that the Advanced Placement Examination worried them. They preferred simply to learn as much mathematics as possible for the satisfaction of the knowledge itself and disliked the idea of the important position of the examination in the program. There was some thought that ninth-grade pupils are rather inexperienced to make a decision as grave as the decision to accept or to decline participation in the Advanced Placement Program. After the content, they valued most of all the excellent training in thinking and studying which they felt they received in their advanced mathematics class.

Both the teachers and the pupils report that the pressure of time is an important problem. They would have preferred a more relaxed approach with more time for class discussion and interplay of ideas. Perhaps the selection procedures were not as discriminating as they should have been, for a number of pupils stated that the whole experience was stimulating and fun. For these pupils the problems of insufficient time and too much pressure seemed not to exist, although some of their parents complained that they could not pry them away from their books.

Study of the problem of what is the best program for pupils who are gifted in mathematics is continuous. In one school it is planned this next year to complete both the seventh- and eighth-grade mathematics in the seventh grade and to begin the study of algebra in grade eight. The plan will be tried experimentally in a class selected from the top 5 to 10 per cent of the seventh grade.

In another school, last year, the most capable pupils in the ninth grade were scheduled for a special algebra class, in which pupils were given an opportunity to move as rapidly as possible and to go as far as they could in the study of algebra. It was anticipated that first-year algebra would be completed with time to spare for advanced algebra. As the year progressed, it became apparent that the interest of the pupils in each topic required more intensive investigation into special cases and the inclusion of examples of increased complexity. In factoring, for example, the pupils studied cubic expression and methods of factoring by grouping. The class emerged at the end of the year having studied the same general topics all the other classes had studied. The difference lay not in the

number of topics, but in the extent of understanding achieved and the sophistication of the generalizations developed.

Once in a great while a pupil appears who clearly has marked ability in mathematics. Such a pupil was discovered in a seventh-grade class four years ago. At the end of the first semester of the seventh grade, he performed perfectly on the semester examination. The school asked him to take the final eighth-grade examination, and first-semester freshman algebra examination, for which he also submitted perfect papers. He was transferred to the algebra class and, as an eighth-grade pupil, he entered the accelerated program leading to the Advanced Placement class. He has now, as a sophomore, completed a year of calculus. Conferences have been held with his family and members of the University of Cincinnati Mathematics Department. It is hoped that it will be possible to arrange a dual high school and college program for him next year.

Although these attempts to meet the problem of the gifted pupil in mathematics have employed acceleration, some experienced teachers still question the adequacy of such a solution. They believe that additional content, rather, should be made a part of mathematics courses for capable pupils in the secondary schools. Moving a pupil rapidly through the traditional program, they submit, does not constitute improved preparation for modern college mathematics. They believe that the problem requires continued thoughtful study accompanied by experimentation with new material in secondary-school mathematics courses. They are prepared to follow through and to give assurance to the able pupil that his special needs are receiving close attention. It may be, in the end, that the best solution will be a combination of both faster pace and altered content for gifted pupils.

The Advanced Placement Program of the CEEB

EDWIN C. DOUGLAS

THE present Advanced Placement Program of the College Entrance Examination Board actually had its origin in the School and College Study of Admissions with Advanced Standing. Educators and school administrators will undoubtedly recognize this program under the more familiar title of "The Kenyon Plan." In its early stages the program was supported financially by the Fund for the Advancement of Education. In 1955 the College Board was asked to administer this program on a national basis, and agreed to do so. Consequently, there now exists a nation-wide program for educating our gifted students at the secondary-

Edwin C. Douglas, the Taft School, Watertown Connecticut.

school level, with a set of examinations in college freshmen level work, suitable both to the secondary schools and the colleges.

These examinations, taken in May of the twelfth grade, are for the purpose of enabling the colleges to grant advanced placement, college credit, or both, to those students who have received a creditable grade. This decision rests solely with the individual college. These examinations must not be confused with the regular achievement tests of the College Board. These latter examinations, together with the scholastic aptitude tests, are for college admission. The Advanced Placement examinations have nothing to do with admissions at all. The tests are directed toward the gifted pupil and serve as a standard yardstick to measure the achievement of these gifted pupils. Information regarding the entire program can be obtained by writing the Director of the Advanced Placement Program, 425 West 117th Street, New York 27, New York.

In mathematics, this means setting up a curriculum whereby the gifted student can accelerate through the full four-year secondary-school program in three years, thus leaving the twelfth grade free for a *bona fide* college freshman course in calculus and analytic geometry. Extreme care should be taken to see that these students are in no way short-changed in the normal high-school mathematics program. Acceleration which prompted neglecting important topics in mathematics would be causing a distinct dis-service to the student.

Different schools approach the acceleration in various ways, each, of course, best suited for the individual school in question. These methods vary all the way from starting algebra in the eighth grade to doing extra work in the summer. Suffice it to say that there is an astonishing degree of flexibility in attaining the desired goal—a calculus course in twelfth grade!

Much of the earlier work in the field of mathematics was done by a committee of which Professor Heinrich Brinkermann of Swathmore College was the chairman. The report of this committee, copies of which may be obtained at the address mentioned earlier, contained a suggested curriculum for grades ten, eleven, and twelve. These suggestions will probably be superseded by the curriculum which will be suggested by the College Board's Commission on Mathematics. Copies of the report of this body are now available. Administrators reading this article would do well to check with their mathematics departments to see if the department is on the Commission's mailing list. Again the address is the same as was listed earlier in this article.

Specifically, the test in mathematics is made out by a committee of six teachers, four at the college level and two at the secondary-school level. In addition, the chief reader, two members of the mathematics section of Educational Testing Service, and the chairman of the College Board's Mathematics Panel also attend.

This group is charged with the responsibility of producing a test covering the normal subject matter contained in a standard college freshman

course in analytic geometry and calculus. Members of the committee submit the items from which the test is eventually constructed. There is no careful pre-testing of these items, as is the case in the achievement tests. Eventually there will be a sufficient backlog of items to permit adequate pre-testing and item analysis. The complexion of the Examiners Committee is such that one could expect only an eminently sound examination.

One of the major, and possibly more attractive, features of this examination is that it is composed of two parts. The first is timed for an hour, and it is completely objective in nature; the second part, timed for two hours, is comprised of ten essay-type questions. The first part is machine-scored, but the second section is read by a group of readers, some of whom are also members of the committee making out the examinations. The composite score, the essay-question section, and a description of the course taken are all sent to the college mathematics department to expedite the ultimate decision to grant credit, advanced placement, or both. This decision lies wholly within the jurisdiction of the individual college mathematics department under question.

The following quotation is taken directly from the bulletin entitled "Advanced Placement Program," pages 121-123.

> The Advanced Placement Test in Mathematics, which is three hours in length, seeks to determine how well a student has mastered the principles, as well as the skills and techniques, of the subject matter outlined above. The test will normally consist of (1) a multiple-choice section which will test proficiency in a large variety of topics, and (2) a problem section, which requires solutions in detail, giving the students an opportunity to demonstrate his ability to carry out proofs and solve problems involving a more extended chain of reasoning. The test is designed to give a complete coverage of the subject matter, and it is not expected that any one student will answer all the questions.

The scores for these tests are reported on a five-point scale as follows:

5 High Honors
4 Honors
3 Creditable
2 Pass
1 Fail

Individual colleges, however, reserve the right to interpret the above scores as they see fit. In several instances, advanced standing with college credit is granted only for scores of 5 or 4.

The growth in the number of students taking the entire program has been most gratifying. In mathematics, the following table shows the approximate upward trend over the last three years.

Year	*Number of students* (approximately)
1956	386
1957	750
1958	1200

These figures would tend to indicate that the gifted student is no longer the forgotten pupil in our academic scheme.

A control group of college freshmen was used to investigate the validity of the examination. It is never fair to make sweeping generalities about two groups when the motivations might not have been the same. However, suffice it to say that the high-school candidates for Advanced Placement in mathematics performed at least as well on this test as certain groups of college freshmen.

There have been many interesting by-products of this program. It has unquestionably led to a move to re-examine our secondary-school mathematics curriculum. Tangible evidence of this is the NCTM Committee on Secondary-School Curriculum, the CEEB Commission on Mathematics, and the popular interest in the University of Illinois Committee on Secondary-School Mathematics.

But even more far-reaching in the writer's opinion has been the splendid way in which college professors and capable secondary-school teachers have come to a position of mutual understanding and appreciation for each other's problems. Out of the Advanced Placement conference held annually in June has come a warm respect for the abilities of those at both levels in our educational structure. Here again we have a picture of a test doing far more than it was ever designed to do. Two important levels of education have been brought into much closer harmony with a test serving as the catalyst.

A Junior High School Seminar for Talented Students

FLORENCE L. ELDER

THE apparent discrepency between the ability and performance of the gifted pupil at West Hempstead High School led to the initiation of the West Hempstead Seminar program in 1954. This program recognizes the urgent need to identify the talented pupil at least by the outset of his junior high-school career.

The Seminar program consists of identification through personal interviews associated with standardized testing and teacher rating. The Seminar program is an attempt to enrich the pupil's present course work without intruding upon his future study. The Seminar program brings to the pupil the challenge of an idea in order to whet his appetite for serious study.

This report is a brief description of the present West Hempstead Seminar program. It is not intended to be an evaluation of its success.

Florence L. Elder, Chairman, West Hempstead Junior-Senior High School, West Hempstead, New York.

Such an evaluation will be made at a later date when adequate follow-up data are available.

Identification

The problem of identifying the gifted is perhaps the most difficult aspect of any such program. In our selection the stress is placed on high intellectual ability rather than on high academic achievement. In the light of interviews by a trained and experienced educator, the standardized test data and teacher recommendations are weighed. We also consider the pupil's personality characteristics, his interest, his determination, and aspirations. His emotional stability, physical fitness, and total behavior pattern are studied. The Seminar program selects about five per cent of the most able seventh- and eighth-grade pupils. Membership in the seventh-grade Seminar does not insure the individual's being selected for eighth-grade participation. His continuance in the program is based upon his personal response to the opportunities and demands of the Seminar. Provision is made whereby qualified students new to the West Hempstead school system may be invited to join the Seminar during the course of the school year. In fact, continuous identification is one of the important features of our program.

Organization

The organizational plan of the West Hempstead Seminar is unique. It provides for regularly scheduled seventh- and eighth-grade classes which meet twice a week during school time. The members are released from two different subject classes (for example English and mathematics) each week in order to attend the Seminar. The students themselves are individually responsible for all work missed during this released time. In addition, they must maintain a superior average in all classes. The Seminar offers no formal credit for participation. It is an opportunity for the student to learn "for the sheer fun of it." There are no written examinations or recorded grades.

In the Seminar classes, the pupils do enrichment-type work in the fields of English, science, mathematics, and citizenship. The seventh-grade program provides an opportunity for intensified work in English and mathematics. During the eighth grade, the student may elect to work in two or three areas of interest. At the initial planning of the Seminar program, it was decided that Seminar work should not duplicate work of regular classes nor should it be directed toward acceleration. There is no attempt to bring senior high-school mathematics into the junior high school. We believe that, through a re-examination and investigation of concepts previously introduced, the student is enabled to broaden his mathematical experience. We shall briefly indicate how the pupil is helped toward a better understanding of "our" number system through an investigation of finite number systems. By personal experience, he learns something about an algebraic structure.

For example, the pupil considers the system with only five numbers in it: 0, 1, 2, 3, 4. This is called a modulus 5 system (written mod 5). We may define the operations of addition and multiplication in this system.[1] Students can easily solve equations in the mod 5 system. To see how this may be done we note that there are only five numbers in the system. All of the solutions of an equation may be found by merely testing each of the five numbers (0, 1, 2, 3, 4) to see whether it is indeed a solution. For example, in the mod 5 system the number 3 is a solution of the equation $x + 2 = 0$ since $3 + 2 = 0$. The number 2 is a solution of the equation $4x = 3$ since $4 \times 2 = 3$ in the mod 5 system. It is quite natural to ask whether each mod 5 equation has a solution. The answer is no! Some equations such as $x^2 = 2$ (mod 5 system) have no solution.

It is interesting and rewarding to examine other finite systems, say the mod 7 system or the mod 6 system. The mod 7 equation $x^2 = 2$ has two solutions, yet the mod 7 equation $x^2 = 3$ has no solution! During this study, the capable student discovers important differences between the mod 6 system and the mod 5 system. By personal experience he will see the need for a careful investigation of this system in forming generalizations. At this point, the student is usually eager and ready to undertake a more serious examination and study of "our" number system as an algebraic structure.

The success of the Seminar is dependent upon the cooperation of all staff members. The program is a unifying school project since it circumvents departmental lines. The regular classroom teacher releases members from his class, but during these periods he has an opportunity to redevelop basic concepts or review fundamental processes (without the risk of boring the gifted!). Seminar teachers work together in planning, implementing, and evaluating the program.

Objectives of the Seminar

The West Hempstead Seminar is an outgrowth of our students' individual needs and the school's philosophy. Initially it evolved because of our concern for talented twelfth-grade students whose class standing and achievement test scores gave little evidence of their giftedness. The West Hempstead program is planned to awaken intellectual curiosity and initiative, and to stimulate creative thinking. The classroom atmosphere and activities encourage investigation and exploration.

Evaluation

The Semniar program has not been in effect long enough for a meaningful evaluation. Students' interest in school is usually increased coincidental with participation in the Seminar program. This is particularly

[1] In addition (multiplication) if the sum (product) is larger than 4, this sum (product) is divided by 5. The *remainder* is then used in the place of the sum (product). Thus, in our system $3 + 4 = 7$ but in the mod 5 system $3 + 4 = 2$. The reader will note that if 7 is divided by 5, the *remainder* is 2. In our system $2 \times 4 = 8$ but in the mod 5 system $2 \times 4 = 3$. (If 8 is divided by 5, the *remainder* is 3.)

gratifying and encouraging in the case of students whose former work was of poor quality. Members feel that the most valuable benefits derived from the Seminar are growth in thinking, research stimulation, and the development of improved study habits.

On the basis of our experiences, we feel that the Seminar program is a means of challenging talented junior high-school pupils. Although students and their parents are enthusiastic about the Seminar, we do not assert that the outcomes are the result of Seminar procedures. At this date no scientific study has been made of the project. It is anticipated that follow-up studies of Seminar members will become a significant part of the evaluation of the program.

SUMMARY

We have briefly discussed the Seminar program as it operates at West Hempstead High School. We feel that the success of the program depends upon the continual, searching, thoughtful detection of the gifted pupil at an early age; that the program must be directed toward providing a broader background for future studies; and that the gifted pupil will respond to the opportunities for more rigorous and challenging study when these are provided.

A Demonstration Class in a National Science Foundation Summer Institute

HARRIET F. MONTAGUE

THE idea of a demonstration class at a summer institute was generated by two separate concerns. First, many teachers who had been to institutes and other workshops reported that, although the material they obtained was stimulating and their subject matter knowledge was considerably enriched, they did not see how they could use it in their own classrooms nor did they have the courage to experiment with it on their own. These reports led us to hope that a class of high-school students as a part of the institute would enable the lecturers to demonstrate how some of the subject matter could be presented at the secondary-school level.

The other concern was for the gifted high-school student. We felt that a month's work with outstanding research men would provide opportunities not otherwise available to the gifted student. There would be opportunity to hear about branches of mathematics not presented in the high-school curriculum and also opportunity to do some small research problems under the guidance of these active investigators.

Harriet F. Montague, Director, National Science Foundation Summer Institute in Mathematics, University of Buffalo, Buffalo, New York.

As a result of these concerns and with the approval of the National Science Foundation, we have had 25 students at each of the Summer Institutes in Mathematics at the University of Buffalo in 1957 and in 1958. These boys and girls had completed the eleventh grade, so that they were mature enough to grasp the subject matter and still had another year in secondary school to take some ideas back with them. They were all outstanding in their achievements in mathematics, superior in all subjects, and recommended highly as good school citizens. Each student received an award under the National Science Foundation grant to cover expenses. There were five to six times as many applications as there were places, making the selection process most difficult.

These Institutes in Mathematics met five days a week for four weeks with a different lecturer in residence each week. The main topics were: (1) The Development of Mathematics, (2) Modern Concepts in Geometry, (3) Modern Concepts in Algebra, and (4) Some Aspects of Applied Mathematics. For one hour each day, the students attended a class where the lecturer presented some of the material he had previously presented to the teacher participants in order to demonstrate how it could be presented to a class of superior students at the eleventh- or twelfth-grade level. For another hour, the students and lecturer were together for a session in which the lecturer suggested small problems in his own field of research for their consideration and further study. During the afternoon, members of the local staff worked with the students. In 1957 the students and teacher participants worked separately during the afternoon. In 1958 the teacher participants worked with the students and there was considerable exchange of information and help.

Our hopes for success were substantially realized. Follow-up correspondence with teacher participants has revealed that many of the concepts presented by the lecturers were used by the teachers in their regular classes the following year. Many topics were used for enrichment purposes. We feel that they were stimulated to these experimental efforts by seeing that high-school students could grasp this material and were eager to do so. The teachers found that, even though the demonstration group was a highly selective one, the ease with which they accepted new concepts indicated that the average students could also understand some of them.

It was surprising at first, but not on second thought, to find the demonstration class more alert in "catching on" than the teachers when new ideas were presented. The students were aware of this, but were no less respectful of the teachers because of it. As one of them put it, "We don't have as much cluttering up our minds as the teachers do."

The most rewarding activity for the demonstration class was the close work they had with the lecturers. The stimulation for both students and lecturers was tremendous. The challenges came to the students from the lecturers at first, but after a day or two the lecturers felt themselves challenged by the work of the students. This spirit of adventure into

creative endeavor carried some of the students into their next year's activity. One of the boys won high recognition in his state Science Fair by enlarging on some ideas from the Institute. Many of the students have reported that their ideas about mathematics have been broadened so that they can appreciate the whole scope of the field much more than they ever could have without this experience. It has made some of them consider careers in pure mathematics whereas before they thought of mathematics only as a tool subject.

There is a question as to the selection of students for such a class. We had superior students; certainly they were not typical of the average group. If they had been selected to serve only as a demonstration group and not as a preliminary training group for potential researchers, we may not have limited it to such outstanding students. The students were not from one school or one small geographical area. For follow-up purposes it might be better to have them from one school or district. We desired to spread whatever influence the students might exert into as many schools as possible. The objectives of the program must be considered in making the selection.

We intend to follow the careers of these students as they go through college. Without a control group, we shall perhaps have no valid conclusions regarding the worth of our program. However, there is conviction on our part and theirs that the demonstration class should be continued.

A Summer Mathematics Camp for Talented High School Students

EUGENE D. NICHOLS

THE educational literature of the past few years abounds in comments to the effect that the education of the gifted students in the United States is given a great deal less attention than it deserves. The belief that the gifted high-school student with a particularly intense interest in mathematics is able to learn rather easily much of the modern mathematics not ordinarily found in the high-school curriculum prompted the Florida State University mathematics education staff to propose holding on the FSU campus a six-week mathematics camp during the summer of 1958. The purpose of the camp was threefold.

1. To identify talented high-school youngsters capable of becoming research mathematicians or exceptional mathematics teachers.
2. To develop and enhance the interests of such young men and women

Eugene D. Nichols is Associate Professor of Mathematics Education and Director of NSF Summer Mathematics Camp, Florida State University, Tallahassee, Florida.

by providing them with new insights into an expanding mathematical body of knowledge.

3. To bring these youngsters into contact with research mathematics and mathematical content of a kind not found in conventional high-school courses, thus providing the students with opportunities to engage in creative mathematical activities.

The National Science Foundation provided a grant of $9,300 to support forty high-school students while attending the Mathematics Camp. This grant was used to pay for part of the instructional staff and to cover student expenses, such as tuition, housing, meals, books, medical services, laundry, and part or all of travel expenses. The Florida State University, in addition to providing physical facilities of its campus, including the electronic computing equipment, library, and laboratory facilities, agreed to contribute $3,600 to cover additional expenses of the Camp.

Students receiving the awards made up two groups. Group I consisted of twenty high-school freshmen who had completed one year of algebra by the end of 1957-58. Group II was composed of twenty students who had completed no more than the eleventh grade by the end of the school year 1957-58 and who had studied three years of college preparatory mathematics.

High schools in the Southeastern United States were given an opportunity to nominate at most two candidates for each group. Because of wide publicity given the Camp, several applications from outside the Southeastern region were received.

Each school which made nominations was requested to administer *Step*[1] *Mathematics Test*, Form 1A, to their nominees. This is basically a power rather than a speed test designed primarily for college freshmen and sophomores. Its intent is to measure students' skill in solving new problems on the basis of given information. The test consists of fifty problems with a maximum raw score of 50. Although such data as school grades, standardized test scores, and I.Q. scores were available for each nominee, the selection committee agreed to use the *STEP Mathematics* score as the main criterion for selection. Out of approximately 1,100 applicants, forty were selected to receive the stipends. These students represented 36 high schools from ten states. Not a single selected student turned down the opportunity to participate in the Camp.

The range of raw scores on the *STEP* test for Group I students who were selected was 36-47 and for Group II, the range was 41-49. Using the norms for college freshmen, the score of 36 falls in the percentile band 94-99.2, and the score of 41 falls off the scale at the upper end.

During the six-week stay on the FSU campus, from June 16 to July 23, the students' school day consisted of three or more hours of instruction in mathematics. One hour a day was devoted to instruction in the Russian

[1] *Sequential Test of Educational Progress*, published by the Cooperative Test Division of Educational Testing Service, Princeton, New Jersey.

language. The remaining hours were spent in attending special lectures and cultural and recreational functions at the university.

Both groups heard the following lectures by members of the FSU faculty and outside lecturers: Missile development at Cape Canaveral (lecture accompanied by slides and movie pictures); numerical weather prediction by means of electronic computers; use of probability in genetics; non-Euclidean geometries and relativity theory; group theory and the vibration of the atoms in the water molecule. The students were also introduced, through three one-hour lectures, to some aspects of mathematical problems connected with the work in ballistics.

In their regular six-week instruction, the students of both groups studied the following topics (in the case of each topic, the work with the students in Group II was carried at a higher level of generality and abstraction): Fundamental concepts of set theory; fundamental concepts of group theory; fundamental concepts of matrix theory; n-dimensional geometry of squares, cubes, *etc.;* edges, faces, hyperfaces, *etc.;* the statement calculus (by means of truth-tables); quantifiers. Group II studied the statement calculus as a deductive system from the treatment of Hilbert-Ackerman, as well as multiple quantification and distribution of quantifiers; programming techniques for IBM 650 electronic computer, including writing programs and executing them on the machine; diophantine equations; perfect numbers; and congruences.

Group I was also given instruction in the development of number systems starting with the notion of set, leading to definitions of a natural number, integer, *etc.* The students also learned to perform arithmetic calculations using various numeration systems; *e.g.,* the binary system. In addition, they were introduced to deductive geometry done in a mathematically rigorous fashion. Group II received instruction in probability and statistics based on the textbook *Introductory Probability and Statistical Inference for Secondary Schools* by the Commission on Mathematics of the College Entrance Examination Board. Outside the scheduled class meetings, the students participated in many types of group and individual sports. With many, playing chess or bridge proved to be the most favorite pastime.

During the Camp, the participants were given a number of standardized tests in mathematics and of general intelligence nature. The mean total score for the group on the *ACE Psychological Examination,* for example, was 143, which corresponds to the 93rd percentile, based on the national norms for entering college freshmen. The mean raw score on the *Doppelt Mathematical Reasoning Test* was 35, which corresponds to the 90th percentile, based on the norms for graduate students in education.

The scores of these tests are clearly indicative of the intellectual superiority of these students. This was corroborated by the experience of the staff that worked with the group. The youngsters learned new subject matter with amazing rapidity and ease. They engaged with eagerness in

creative activities. The more esoteric the topic, the more they seemed to enjoy exploring it.

The mathematics-education staff at the Florida State University is presently engaged in evaluating the results of the 1958 Summer Mathematics Camp. The results of various tests, evaluation questionnaires, and the teachers' observations are being studied. Plans are also being made to carry out some follow-up studies.

At this writing, it is hoped that the National Science Foundation will wish to continue and expand their support of such programs. If not, a variety of other sources of financial support are probably available to those desirous of undertaking similar programs in their localities. The staff at FSU would make a suggestion that such programs be conducted on a college or university campus, in order to make use of library and computing facilities and to enlist the aid of a well-qualified mathematics department. The use of outside lecturers from governmental and industrial research organizations is strongly recommended; with a proper understanding of the nature of the program, there should be little difficulty in obtaining such help.

In attempting to evaluate a venture of the kind represented by this Camp, one must inevitably recognize that, in addition to tangible results, there are some outcomes which, perhaps classifiable as intangibles, invariably escape the attention of the "cold-blooded" evaluator. Perhaps the best way to hint at such results is to quote a rather typical comment which a Mathematics Camp participant has put in writing:

> I know that math camp has meant a lot to me in ways that will appear only later. There are many things though that I can see now. . . . I have come to realize that higher math is not something every person needs to know to be successful in life. But, it is a *science* and thus something that an inquisitive mind will want to understand. . . . Never before have I met so many people who are so completely different in backgrounds, personalities, and everything. It has been a wonderful experience for me to be with so many young people who have widely differing views and a desire to express them. I feel that I have made many lasting friends and I hope that I can keep in touch with many of them. . . . Thanks again for giving me one of the very brightest spots in my life.

A Mathematics Field Day

MORTON R. KENNER

THE enthusiasm of our area (Southern Illinois) youngsters for our mathematics field day surprised even the most skeptical persons on our staff. The success of the field day was an object lesson to all of us. It demonstrated that there is a vital need for giving students interested in

Morton R. Kenner, Southern Illinois University, Carbondale, Illinois.

mathematics socially acceptable forms of recognition outside the classroom.

The Field Day

The Mathematics Field Day was held at University School, Carbondale, on Saturday, April 19, 1958. Forty-four high schools participated (out of about one hundred fifty schools which had been invited). Each school was permitted to bring a maximum of five students from each school class —a total maximum of twenty students from each school. The schools had pre-registered their students by mail and hence all those attending were able to report directly on arrival to pre-assigned rooms.

The high-school students took a competitive examination in mathematics from 10 A.M. to 12 NOON. There were seven categories of exams: Freshman, Class A; Sophomore, Class A and Class B; Junior, Class A and Class B; Senior, Class A and Class B. The mathematical background of the students was used to differentiate Class A from Class B. Thus, for example, a Senior, Class A, was a senior who had taken (counting the current year) four years of high-school mathematics; while a Senior, Class B, was a senior who had taken only three years of high-school mathematics. Differentiating in this way resulted in students competing only against other students with similar (but not identical) mathematical backgrounds.

After the examination, the students were escorted in groups of 30-40 on short tours of the campus, and (on a staggered timetable) to lunch at the university cafeteria. The groups were pre-assigned so that students from different schools lunched together. During the lunch period, discussion of mathematics and opportunities in mathematics was encouraged by the chaperones, who were undergraduate students and hence close to those from the high schools.

At 1:30 P.M. all of the students assembled in the University Auditorium where the following program was presented.

1. "A Method of Discovery in Algebra" (A 45 minute talk by W. W. Sawyer, the British mathematician)
2. "Communication Theory"
   a. Information Bits—David Phillips
   b. Information Transmission—Dennis Bechtlofft
   c. Redundancy—Janet Messerli
   d. Noise—Lawrence Larson

      (These four were a series of 10 minute talks prepared by mathematics students at Southern Illinois University)
   e. "A Communications Primer" (A 20 minute film)

After the program, the teachers joined the students in the auditorium and the awards from the morning competitive examination were presented. Sixty-seven awards (certificates suitably engraved, sealed, and signed) were presented. A first place, second place, and several honorable mentions were given in each of the above-mentioned individual categories.

In addition, team awards (a team being a minimum of three persons) were given. That is, the raw scores, say, of all senior entries from a given high school were averaged. This average was then used to determine a first place team award, *etc.* Following the presentation of the awards, the author of this article quickly closed the day's activities.

Planning the Field Day

At a meeting of area high-school teachers, held in the spring of 1957, it was suggested that a mathematics field day be attempted the following year. This particular meeting had been devoted to discussions centered about the general problem of motivating high-school students in studying mathematics. The suggestion of a field day was not greeted with any great enthusiasm. The amount of work involved is fairly extensive and it was questionable whether a field day could really contribute to motivating students in mathematics. In fact, there were those who felt that a competitive examination might even have negative results. Two serious objections were raised.

It was felt by some that if a competitive examination were held, many teachers would spend an inordinate amount of time priming their students for the examination rather than teaching mathematics. Coupled with this objection was the fear that many teachers would feel that they—and not the students—were being tested. The point was made that if our goal was to improve the mathematics program in the area high schools, one way *not* to achieve this goal was to place teachers on the defensive by using examinations to evaluate their teaching. This objection cannot be dismissed lightly and it is quite possible that some schools did not participate because of this second fear. Nevertheless, it was agreed to go ahead, but to attempt to minimize the above-mentioned fears from materializing. The author agreed to implement the decision of the group and plan the details for the field day.

In order to minimize the priming of students for the examinations, it was decided to prepare questions which tested mathematical maturity and understanding rather than specific techniques. In order to minimize the feeling of teacher evaluation, it was agreed that no scores would be made generally available. Naturally, the winning students and their schools would be announced, but there was no way that any teacher could compare his or her students' scores with the scores of all the students. In fact, the winning scores were not even announced—only first place, *etc.* It is interesting and encouraging to note in this connection that some students from twenty-three of the forty-four schools participating received awards of some kind.

About January 1, a mailing was sent out to all high schools in Southern Illinois inviting them to participate in the Mathematics Field Day. Included in this mailing were pre-registration cards for students, to be returned by March 15. By having the students pre-register, it was possible

to mail back to each before April 19 the individual room assignments so that much confusion was avoided on the field day itself. Organizing in this way also had certain other administrative advantages. It permitted us to know how many examinations for the different levels to have printed. It enabled us to plan carefully in advance our scoring procedures (by machine) so that we could, in fact, announce the winners that very afternoon. It enabled us to plan relatively smooth luncheon arrangements. And finally, it enabled us to know a month in advance the type of students who would be attending so that we could plan an afternoon program properly pitched.

Southern Illinois is an area of small high schools (average enrollment about 300) and, as a result, there are generally few students in each individual school who can furnish stimulation to each other to go beyond classroom work in mathematics. A field day, such as the one described above, can offer a goal and challenge to the mathematics students. It can provide them with an artificial motivation to prepare, individually for the year, much as an interscholastic sports program does.

It is important to note, however, that the field day was *not* just an examination. The major portion of the day was spent in activities which allowed students from different schools interested in mathematics to associate with each other, to share problems and insights, and to define mutual goals. It permitted us at the college to acquaint these students with new areas of mathematical activity and to provide them an opportunity to hear a world-famous mathematician, whose talk, incidentally, was perfectly pitched to their level. The field day gave these students a feeling that mathematics was important and that their interest in mathematics was right and proper.

The objections to the field day, discussed in the comments on planning, were to a large extent satisfactorily minimized. Individual teachers were delighted with an opportunity of competing in their own schools with a healthy extracurricular activity. They felt that the field day helped give prestige to their own efforts in stimulating youngsters toward individual work in mathematics. They did not feel that they were being put on the spot; in fact, it seems probable that many more schools will participate again.

Chapter IV

Articulation Between Elementary and Secondary Schools

The Importance of Articulation

PHILLIP S. JONES

PROBABLY no experienced teacher or school administrator needs to be convinced that continuity and articulation in our school program are important. If so the fact that two substantial current publications[1] are largely devoted to these topics should emphasize that consideration of this problem is particularly timely, as well as important. Further, data gathered in connection with the first of these two studies shows that, of the various situations in which students reported help or hindrance in their progress through school, subject matter and moving to the next school level ranked third and fourth in importance as judged by the frequency with which they were mentioned. This seems to give particular importance to the problem of the articulation between elementary and secondary schools of their mathematics programs.

This observed importance is well explained by psychological and philosophical considerations which also give some clues as to how to work toward improved continuity and articulation. It seems well established that *meaningful learning*, learning with *understanding*, is easier, retained longer, and more likely to transfer to new situations. Meanings and understandings, however, are not absolutes or all-or-none insights which are achieved at some particular instant. Meanings and understandings grow, develop, and expand throughout one's life. Rarely if ever can one who pauses to think and say "I fully understand that. I comprehend all that there is to be understood about it." Meaning is a continuum, always capable of being extended or having gaps, perhaps unperceived at first, filled in. This expansion of one's understandings and insights develops as one perceives similarities, analogies, and relationships between new concepts and ones which have been met earlier. This growth takes place, then, as one meets old principles and processes in new

[1]Association for Supervision and Curriculum Development. *A Look at Continuity in the School Program.* 1958 yearbook. Washington, D.C.: the Association, a department of the NEA, 1958.
National Council of Teachers of Mathematics. *The Growth of Mathematical Ideas, Grades K-12.* Twenty-fourth yearbook. Washington, D.C. The Association, a department of the NEA, 1958.

Phillip S. Jones, University of Michigan, Ann Arbor, Michigan.

situations, sees new applications for old ideas, observes old ideas as special cases of new, or finds that a new and apparently distinct concept has connections with ones learned earlier. Even those sudden perceptions so delightful to both pupils and teacher in which "the light dawns" are probably never the bolts-from-the-blue which they seem, but happen only when a concept has been met often previously, though perhaps in different terms and contexts.

The implications of this for teachers and curriculum planners seem clear. In lesson planning teachers need continually to look both forward and backward. They need to look for those threads of continuity begun in earlier years to which they may attach the ideas which they are helping youngsters to develop. Further, they must look at concepts which are to be developed in later years and search out ways to prepare youngsters to understand them by directing their attention to elementary special cases and introducing, even though briefly and simply, ideas which will grow in importance later. For example, mathematicians find the distributive law to be a frequently recurring fundamental idea of more importance than can be explained in this short space. However, this law occurs and is used in some way at nearly all levels of instruction. This law stated in algebraic symbols is $a \cdot (b + c) = ab + ac$. Neither the words "distributive law" nor the symbolic representation need be used anywhere in the elementary school, but the principle and its frequent recurrence should be perceived by elementary-school students. They are likely to perceive it, however, only if they are led to do so by teachers who are aware of its importance and alert to its recurrences. Thus when a youngster sees that three toys priced at two dollars and ten cents each will cost six dollars and thirty cents, he is using this principle; $3 \times (2 + 10) = (3 \times 2) + (3 \times 10)$. Similarly the total weight of two packages containing one pound and six ounces each is two pounds and twelve ounces, or to cut three boards each 2′ 1″ he will need a board at least 6′ 3″ long. This same principle is used in multiplying 3×21. Since 21 really means $20 + 1$, 3×21 really means $3 \times (20 + 1) = (3 \times 20) + (3 \times 1) = 60 + 3 = 63$. Of course the student eventually learns and practices an algorism in the form $\begin{array}{r} 21 \\ \times\ 3 \\ \hline 63 \end{array}$

But, if understanding is to precede the formulation of algorisms and drill, he must first understand and use that which years later he may learn to call the distributive law. This law is also the basis for many other processes from elementary school through advanced mathematics such as factoring, special products, and the explanation for the definition of the sign laws in junior high-school algebra. It is also to be found in relationships between areas which may be noted both in algebra and in the intuitive geometry of the earlier years.

For teachers to be able and willing to point out and use these central continuing themes, they need first be aware of their existence and scope,

and secondly they must recognize that not all of these concepts can or should be taught at their first appearance for the mastery and understanding which ultimately we hope the student achieves. By this we do not mean that mastery and understanding are unimportant, that progress toward appropriate levels of achievement should not be measured, nor that we should be content with less achievement than that of which the individuals in our class are capable. We do mean that the possibility of complete mastery and understanding is not the sole criterion for the inclusion of a topic in a curriculum or the pointing out of a relationship in a daily lesson plan. Seeds which are not planted cannot be expected to grow, and teachers who are delighted by the progress of a class should not loose their joy in their own achievement, but should realize that just as they are reaping harvests sown by their predecessors, so they too must at times sow where they may not reap.

To identify these central or continuing themes in mathematics instruction and to show clearly and concretely how they can be a conscious part of the instructional program at all grade levels is not an easy task. The second of the two works cited at the beginning of this article attempts to do this. It discusses *number and operation, relation and function, proof, measurement and approximation, probability and statistics, symbolism, mathematical modes of thought, psychological teaching-learning principles.* It is clear that not all of these central concepts are or should be equally prominent at all grade levels. Number and operation are probably more all-pervading vertically than are probability and statistics. This latter topic is a relative newcomer to the roll of central ideas in elementary- and secondary-school mathematics. Wo do not yet really have well developed definitions of the amount of it to be taught, or when or how. However, its rapidly expanding role in both pure and applied mathematics, even daily living, has convinced many that it belongs in this category.

Many of the concepts listed above have for years been taught at some and perhaps all grade levels. But even where this has been done, teachers may deliberately point out the importance and recurrence of basic ideas more frequently than they do. For example there is room for much more attention to be paid to the notion of proof and logical structure in arithmetic and algebra. We can check subtraction (division) by addition (multiplication) not by a happy accident, but by virtue of the fact that subtraction is *defined* as the inverse of addition. Thus six minus two really means, what added to two gives six? If this were stressed all along from the earliest grades, we would be teaching basic ideas which extend to new situations as well as a mechanical device for checking.

To get our school systems to improve in this respect (much good work is being done) we must (1) be sure that mathematics teachers understand the basic ideas themselves, (2) encourage them consciously and deliberately to seek out and use continuing threads in daily teaching, (3)

provide for joint vertical staff meetings where talk of the nature and role of these continuing ideas is discussed in an interested and purposeful atmosphere. In other words, looking for the nature of the central ideas and the steps in their continuing development may provide a perspective view of the entire mathematics program which may effect both teaching and the content and organization of the curriculum.

This viewpoint may explain the apparent contradiction in the first of the two works cited in our introductory paragraph. On page 88 it says, "Curriculum sequences based on the logic of subject matter may be inadequate as a basis for the continuity of learning which our schools should provide," while on page 133 it says, "An answer seems to lie in the identification of certain basic concepts, . . .," and on page 93, "New material to be learned will be meaningful insofar as the learner is able to see relationships between the elements of the new learning and the things he has previously understood or experienced. He must also have a mastery of abstractions, . . . Most teachers know that the learning of any school subject, particularly one with a great deal of logical relatedness, like science or mathematics, is more meaningful and permanent if the student understands it *as he goes*." These two statements may be reconciled by our earlier observations that: (1) understanding, and in mathematics this means understanding of logical relationships as well as social applications, is important, but that, (2) an order and technique of presentation which is determined solely by the final and most abstract formulation of a subject may not be the best pedagogically.

The essence of mathematics is abstractness; a single mathematical concept may be interpreted and applied in a variety of different ways. Even the idea of cardinal numbers, 1, 2, 3, 4, . . ., from sets of objects (candy, marbles, dolls, *etc.*), is abstract. Further the foundations of mathematics (and I am deliberately using mathematics not arithmetic here because, even at an elementary level, the objectives should be much broader in both content and concept than the mere manipulation of numbers which some people associate with arithmetic) lie in its logical structure and the process of proof. However, understanding of these will be achieved neither by imposing on elementary mathematics the logical structure of the graduate school nor by ignoring abstractness and structure entirely or even in part. An understanding of both the logical structure and the way in which ideas grow and develop will enable teachers to plan a continuing emphasis on the central themes of mathematics.

These themes include mathematical modes of thought; *i.e.*, problem solving and reflective thinking. This process is aided and tested by a knowledge of the structure of mathematics and its logic, but it also requires intuition, insight, intelligent trial and error which cannot be taught in a unit or by a chapter in a text. These are taught by continual use of "discovery" teaching techniques, continual stimulus to the pupil to ask "why?" and continual giving of assistance and direction to him in

his search for "why?" Students and teachers find it difficult to turn on and off at will, as one goes from grade to grade or class to class, an inquiring attitude and a thoughtful developmental approach to new situations. Continuity, not uniformity, in the pursuit of the goal of developing pupils' ability to think is, therefore, most essential. This says that continuity, not uniformity, in teaching methods or at least in the spirit of inquiry and discovery is important. Both elementary-school teachers who give only rules or examples followed by drill and secondary-school teachers who do all the telling exist. Both need to turn to the better practices of the many fine teachers who exist at both levels. Further, all can profit from exploring together vertically the objectives of our instruction and the continuing central themes which should exist and be exploited throughout grades K-9 with respect to both content and teaching approach.

Mathematics As a Man-Made Invention in the Elementary Classroom

M. VERE DeVAULT

WE ARE living in an increasingly complex scientific age. It is an age in which the quantitative aspects of technology touch each of us. Effective living requires an understanding of both the technology and the language man has developed to communicate its characteristics—mathematics. In this brief article, the author discusses some of the ways in which elementary teachers are contributing to the development of pupils' understanding of mathematics as a man-made invention.

Quantitative relationships exist in our environment. The "threeness" of a clover leaf, the shape of a crystal, the division of a cell, all exist independent of man. Throughout the elementary curriculum, primary importance is placed on increasing the pupil's awareness of the quantitative nature of his many experiences. Man's invention begins with his attempt to communicate to others the quantitative characteristics of his environment and experience.

Three important routes through which teachers are approaching an understanding of the man-madeness of mathematics are: (1) an understanding of symbolism in mathematics, (2) an understanding of the systematic organization of quantitative symbols, (3) the story of man's creation and use of symbols and organization of symbols. Elementary classroom teachers contribute to each of these objectives in a variety of ways.

M. Vere DeVault, The University of Texas, Austin Texas.

Teaching an Understanding of Symbolism in Mathematics

Even though many elementary teachers are themselves unaware of "set" theory, the classroom practice of these teachers has made extensive use of sets. Whereas most instruction twenty or thirty years ago might have begun with a presentation of number facts, teachers today develop in pupils an understanding of the use of arithmetical symbols. Early in their experience, they relate the symbol to sets of actual objects which can be seen and handled. These sets include books, chairs, children, windows, blocks, pictures, *etc.* As symbols become meaningful representations of concrete objects, teachers begin to include semi-concrete sets as shown in pictures and drawings. Only after the symbolism of number is understood does the teacher take pupils to the symbolism of the addition or subtraction fact. The fact 2 + 4 is a symbolic representation for the combining of two distinct sets—one of two objects and another of four objects. Understanding of this symbolism is improved as teachers provide many experiences through which pupils see the combining of groups which is represented by written facts.

In later grades, the use of traditional symbols only can leave the impression that there is something magic about the particular symbols we use. To avoid this impression, teachers substitute new symbols for those which we normally use. A circle may be used to represent a set of three; a triangle may represent a set of five; a rectangle may represent a set of four, *etc.* Pupils are encouraged at times to develop their own number symbols. In at least one currently used textbook, algebraic symbols a, b, c, n, *etc.* are used with children as early as grade three.[1]

Teaching an Understanding of the Systematic Organization of Quantitative Symbols

When primary-grade pupils understand that 11 is one ten and one more, a basic knowledge of our number system is well underway. Classroom collections started by pupils can be organized in such a way that, as new objects are added to the collection, they are placed ten in a row. Pupils count and write ten and two more; two tens and four; two tens and five; *etc.* as objects are added a few at a time to the collection.

In the intermediate grades, an introduction to bases other than ten adds to the development of an understanding of the systematic organization of quantitative symbols. Consideration of bases 12 and 60 with which children are familiar through the use of dozens and time, respectively, adds much to an understanding of our own base 10.

---

[1]Buswell, Guy T.; William A. Brownell; and Irene Sauble. *Teaching Arithmetic We Need.* Boston: Ginn and Company. 1955.

Teaching the Story of Man's Creation and use of Symbols and Organization of Symbols

The Wonderful World of Mathematics[2] and the four-volume *The World of Mathematics*[3] include a vast array of fascinating information about mathematics. In our school curriculum, we often find little of this fascinating world and at the same time wonder why mathematics is not always a challenging, exciting adventure for pupils. Some teachers are finding ways of bringing the story of mathematics into their classrooms. Additional materials for both teachers and pupils are needed although some notable beginnings have already been made. The two sources mentioned earlier are excellent. Materials for younger children by Larson[4] tell the story of counting, of zero, and of other mathematical inventions. Multiplying and dividing in the manner of the seventeenth century mathematicians[5] prove to be of interest to intermediate-grade pupils and at the same time contribute to their understanding that arithmetic has not always been as it is generally taught in our schools today. The story of the history of mathematics is complete with information which when made available to pupils helps to dispel the concept that mathematics is but a set of rules and techniques to be mastered. In its place is built the concept that mathematics is a constantly on-going search for the best way to represent with symbols the quantitative characteristics of the objects and experiences with which we are involved.

Problems Facing Curriculum Workers

As has been shown, elementary teachers are contributing to the development of an understanding of mathematics as a man-made invention in many ways. However, if significant contributions in this direction are to be made, imposing hurdles must be overcome. *First*, materials for both teachers and pupils need to be developed and made available in our schools. *Second*, through pre-service and in-service activities, teachers must be made more conscious of the need for such an approach, and, *finally*, through cooperative efforts, elementary, junior high-, and senior high-school teachers must plan for continuity in the goals of mathematics instruction.

---

[2]Hogben, Lancelot. *The Wonderful World of Mathematics*. New York: Garden City Books. 1955.

[3]Newman, James R. *The World of Mathematics*. New York: Simon and Schuster, 1956.

[4]Larson, Harold D. *Enrichment Program for Arithmetic*. Evanston: Row, Peterson and Company. 1956.

[5]Swain, Robert L. *Understanding Arithmetic*. New York: Rinehart and Company, 1957.

The Supervisor, the Teacher, and Articulation Between Elementary and Junior High Schools

ROLLAND R. SMITH

THE problem of what the teacher thinks about the past training of students in any one of his classes is a perennial one. As a matter of fact, the college professor believes that the students coming to him do not know as much as they used to know. The senior high-school teacher thinks very poorly of the product that comes to him from the junior high school. The junior high-school teacher is of the opinion that all that is done in the elementary school is to have a good time. The elementary-school teacher blames the teachers of grades below her and especially the kindergarten teacher. About the only thing left for the kindergarten teacher is to have a conference with the mother who says the child "always did take after his father."

One of the best antidotes for this poisonous attitude is to have a teacher take the same pupils in successive grades in successive years. He will learn that many of the things he taught have been forgotten and have to be learned over again. It would be salutary if every junior high-school teacher were required to teach for at least two years in the sixth grade. He would find then that the role of the elementary-school teacher was not, as he may have thought, a play watcher.

It is not surprising when teachers feel a lack of articulation between almost any two grades that there should be an even larger seeming gap between the elementary and the junior high school and, in most places, between the sixth and the seventh grades. From the very nature of things, the elementary-school teacher thinks more of the pupil and less of the subject, while, from the seventh grade on, more and more weight is put on subject matter.

The key to the situation is a supervisor in mathematics who has jurisdiction over both the elementary and secondary schools. A man (or woman) who has sufficient knowledge, experience, and inborn capacity to cover so wide a field may be hard to find, but he exists. He can be found if a school system wants him badly enough. Such a man should be familiar with teaching problems from the kindergarten through the senior high school. He can see that the same philosophy of teaching prevails all along the line. If meaningful teaching predominates not only in the elementary school but also in the junior and in the senior high schools, teachers will be familiar with the art of studying individual pupils and their needs, taking them where they find them, proceeding from there, and realizing that they are responsible for the pupil for that year. They have no background for the feeling that they can blame the teacher of the previous grade.

Rolland R. Smith is Coordinator of Mathematics in the Springfield Public Schools, Springfield, Massachusetts.

The curriculum guide in mathematics, worked on with the supervisor as a consultant, can aid in better articulation between the sixth and seventh grades. Very often there are options in the sixth-grade guide. Slower pupils do not study this or that. Yet the seventh-grade teacher may not know about these options. He thinks that all his students should have a background of just so much and if a pupil does not have this background, the teacher is, to say the least, unhappy. Very often the teacher's guide for the junior high school is in a separate booklet, making it just that much harder for the seventh-grade teacher to understand what has gone before. The supervisor should see that the guide for the seventh grade contains a summary of what is expected of sixth-grade pupils.

Of one thing every seventh-grade teacher may be sure. Some of the students entering his classes, just so long as the present philosophy of education prevails, will not be up to what he thinks is seventh-grade standard. Some of them, according to standardized tests, will be retarded by as much as two years. (Pupils retarded more than two years should certainly be in special classes and receive special treatment.) The poor we have always with us. This sort of thing will cause less difficulty if the supervisor is at hand for consultation and to hold meetings where the difficulties are brought out into the open and discussed freely.

Ability grouping will help. If a school is large enough, the slower pupils can be placed in classes by themselves and treated accordingly. It is better in all grades for the slower pupils to study topics of the grade he is supposedly in than to be working all the time with subject matter below his grade. For example, a slow pupil in the sixth grade is better off to be studying decimals (usually a sixth-grade topic) on a fourth-grade level than to be ignoring decimals because he is not so good as some others in his sixth-grade arithmetic. It is better because, when he gets to the seventh grade, his teacher will not be able to say that he has missed topics.

In smaller schools where pupils of varying ability must be all in the same class, the principles of "levels of learning" may be put into practice. All students will study nearly all the topics. Differentiation will not be in topics but in subtopics. The slower pupils will be expected to complete the work on the understanding level and proceed to the simplest kind of computation and reasoning on the topic, but they will not be expected to go beyond their depth. Good and superior pupils will pass quickly to a higher level of difficulty.

Smooth articulation between the elementary and the junior high school, we say again, is a perennial problem. Much can be done to make it smoother if there is some one in charge who has it as his responsibility to make it smoother. There seems to be two aspects of the problem. The pupil going from the elementary school to the junior high school is often confused by the largeness of his new school and the differences in the attitude of the teachers. The teacher, on the other hand, finds some of the pupils below what he thinks the standards should be. Both aspects of the problem will be alleviated if the suggestions offered here are followed.

Concepts Pervading Elementary and Secondary Mathematics

H. VAN ENGEN

THE strength of mathematics lies in the ideas which pervade whole segments of the subject. In the elementary and secondary school the thread of ideas is particularly noticeable if attention is not focused too strongly on individual items which have no binding force, such as number combinations. The fact that the ideas which provide unity for school mathematics have not been brought out in instruction can be accounted for by the excessive emphasis placed on the facts of elementary mathematics, and the "getting the answer" attitude in problem solving, without thought of the large *basic* ideas which should be brought to the pupil's attention in every grade.

This article will not discuss such things as number combinations and how to do division. These are the trees of the forest. We need trees to make a forest, but at this time it is the forest that holds our attention.

Concepts Pervading School Mathematics

There are many or few concepts pervading school mathematics, depending on how much of the subject one wishes to see at a glance. If one looks at the entire subject, it soon becomes apparent that a given concept can be further analyzed into sub-concepts. For our purpose we will resist discussing sub-concepts and dwell on major ideas only.

Enumeration Systems. One of the first things a child learns in school and in the home is how to enumerate a group of objects. At first he does this by assigning individual names to collections; that is, one, two, three, *etc.* The child is soon taught that it is best to adopt a base (ten) for his enumeration scheme in order to simplify the system.

As he progresses in his learning, he finds out that a base other than ten can be used to systemize counting. This opens the way for an extensive study of enumeration systems in the elementary and secondary school. Such a study would include the binary system which has assumed an ever greater importance in the past decade due to the extensive development of digital computers.

The Number System. Once the child learns that the symbol '3' can be applied to a particular group of apples, grapes, dogs, planes, and so on *ad infinitum*, he has a foundation for a major abstraction; namely, that '3' is attached to that which is common to all the above mentioned groups. Of course, this idea is never verbalized in the lower grades. While the germ of the idea is dominant at this stage, later it can be "removed" from the object for its full abstract value. Of course, the same process occurs for all numbers.

H. Van Engen, University of Wisconsin, Madison 6, Wisconsin.

Soon after his first experiences with arithmetic operations, the pupil should be introduced to those properties which are common to all those things we call numbers. Let us assume that the pupil is studying whole numbers (positive) and has not, as yet, thought of fractions as numbers. At this stage he should learn that:

1. When we add or multiply any two whole numbers, we always get another whole number. (This doesn't happen for subtraction and division. Thus $16 \div 5$ is not a whole number.)
2. The numbers are interchangeable for addition and multiplication. For example, $2 \times 3 = 3 \times 2$ and $3 + 2 = 2 + 3$.
3. Grouping numbers by twos in any order is always permissible in multiplication and addition. For example, $3 \times (2 \times 4) = (3 \times 2) \times 4$ and $(3 + 2) + 4 = 3 + (2 + 4)$.
4. The operation of multiplication may be "distributed" over the operation of addition, for example, $2(6 + 4) = 2 \times 6 + 2 \times 4$.

Having learned these fundamental principles in the elementary school, the pupil learns to develop a general way by which to state these principles in the secondary school and he learns that any collection of mathematical entities which possess the properties listed above will be called numbers. Thus he finds that fractions, positive numbers, negative numbers, and complex numbers all possess these properties. Of course, they possess others as well, but such things as $3 + i$ and $2 - 5i$ are numbers because they can be manipulated in the same way the whole numbers were manipulated in the above examples.

Number Pairs and Sets of Number Pairs. The elementary school pupil soon learns that it takes two or more numbers used as pairs to describe some physical situations. He learns to use the form a/b as a pair of whole numbers to describe situations involving fraction ideas, and he learns to use this same form to describe ratio situations.

Late in the elementary school, the pupil works with sets of number pairs. Thus he might make up a table of number pairs showing how much 1, 2, 3, 4, . . . 12 tickets to the school circus will cost at 25 cents each. This is a number-pairing activity. A number representing the number of tickets purchased is paired with the number representing the cost of the tickets. In an arithmetic class, the pairs may be graphed to obtain a visual way of reading the pairs or to see the general trend of increased cost *versus* increased number of tickets purchased.

In the secondary school, pupils learn to write a rule ($C = 25n$) showing how the numbers are to be paired. Such activities serve as an introduction to the idea of variable, formula, set of numbers and a set of number pairs, and generally to the subject of algebra itself. Advanced work will introduce such topics as relations, functions, and set-functions, all of which are based on the pairing of numbers, writing rules to enable one to pair numbers, and similar activities.

Geometric Concepts. The study of geometrical forms and their properties is an integral part of mathematics. As with number ideas, certain

very important geometric ideas have their origins in the elementary schools.

As in our previous discussion, we will not consider the minutiae such as learning names, classifications, and sub-classifications. These are important, but space does not allow us to discuss them.

In the elementary school, pupils learn that it is possible to assign numbers to collections of points. For example, to each collection of points in space that make up a square they can assign the number 4 (for 4 sides or 4 vertices). This doesn't prove to be of much interest. However, to each square a number may be assigned by use of other rules. Thus, to each square we can assign a number which is the measure of one of its sides (or the sum of the measures of its sides). Of course, there are other numbers that can be assigned to each square. We can assign a number to each square which is the measure of the area enclosed by the square or the length of a diagonal.

Elementary instruction is concerned with finding rules whereby these numbers may be assigned to each geometric configuration. These, however, are details—but important details. In the secondary school, we continue this search for rules whereby numbers may be assigned to collections of points, which are usually given a name such as square or rectangle. In fact, we prove that certain rules must hold if we agree to accept sentences (postulates) as fundamental for our science.

Conclusion

We have enumerated three very basic ideas which have their origins in the elementary school and which can only be brought to "full fruit" at more advanced levels. The point that is of importance here is that these ideas *must* be emphasized in elementary instruction. Too frequently elementary (and secondary) instruction ignores fundamental concepts and places its emphasis on memorization of facts without providing the cement to make the facts bind into a whole. This is why some feel that the elementary school stunts the mathematical growth of children. Children can grasp abstract ideas; in fact, they enjoy them. The forward movement in mathematics can only come if we learn how to teach abstractions and how far pupils of varying abilities can go in making mathematical abstractions.

Providing for Individual Differences by Grouping in Depth

R. L. MORTON

PROVIDING an instructional program which is adapted to the wide range of ability levels among pupils is one of the most difficult tasks in teaching. The task is difficult in the lower grades of the elementary school, but it becomes more and more difficult as the pupils become older. Consider, for example, two pupils one of whom has an I. Q. of 75 and the other, 125. At the age of 6, the first child has a mental age of 4½ and the second, 7½. This means a difference of 3 years in their levels of mental growth. But at the age of 12, assuming that the I.Q.'s remain constant, the first pupil has a mental age of 9 and the second, 15. There is now a difference of 6 years in their levels of mental growth. Surely, it is more difficult to provide an instructional program suitable to pupils scattered over a 6-year range in mental development than is the case if the pupils are scattered over a 3-year range. Furthermore, the range becomes still greater beyond the age of 12. And the extremes found in a school population are frequently represented by pupils whose I. Q.'s are lower than 75 and higher than 125.

The literature of education contains many discussions of the advantages and disadvantages of homogeneous grouping. Without attempting to summarize these discussions, we would merely remind the reader that in many schools homogeneous grouping is not feasible and, in others, is not possible. How can the teacher best provide for the needs of pupils representing a wide range of ability levels when those pupils are all members of one class? In the following paragraphs, an attempt will be made to provide, briefly, an answer to this question.

The plan here described may be designated by the phrase, "Grouping in depth." When the class as a whole has covered a unit of work—a unit which requires two, three, or four weeks for completion—a diagnostic test is given. The test covers all of the essential ideas in the unit. The results of this test indicate that the pupils may be classified into three groups which we may call: (1) the slower learners; (2) the average learners; and (3) those who excel. The experiences provided for the three groups are now differentiated.

The slower learners. The slower learners need to go back and restudy one or more—usually more—of the basic ideas comprising the unit of work just completed. If the test is diagnostic, the ideas which must be restudied are clearly identified for each of the pupils by the items missed on the test. Indeed, each item of the test may be accompanied by a reference to the page or pages on which the essential ideas required by that item were developed. Each pupil sees for himself what his weak-

R. L. Morton, Ohio University, Athens, Ohio.

nesses are and where his deficiencies lie. He turns back to the indicated pages one by one, restudies the development there, and works a number of the exercises given for practice. Special sets of exercises should be prepared for this purpose. The teacher gives such help as is needed. The nature and amount of help will differ considerably, even among those here classified as "the slower learners." The teacher must be the judge as to the kind of help to be given, the amount of help to be given, and the time to be spent in restudy.

At the end of the period of restudy, the slower learners are given another test. This test parallels in content the diagnostic test which preceded it. It provides the pupil and the teacher a chance to discover how effective the restudy has been. This test should be prepared in advance by the teacher or by the textbook author, preferably the latter. This second attainment test may indicate that there are still some pupils who have not mastered the unit of work. Whether or not time can be taken for further restudy must be decided by the teacher. There is a limit, of course, to the extent to which a class can be delayed while the slower learners try to catch up. The plan here described will salvage several, at least, of those who might otherwise be lost.

It will be noted that this restudy plan for slower learners is much more than the mere provision of practice, or drill, for those who are weak. The first need of these pupils is *another opportunity to learn.* Drill will follow the restudy, of course, but it cannot take the place of restudy.

The average learners. Most of the problems incident to any plan for providing for individual differences arise with the slower learners and with those who excel. While we are making special provision for these extreme groups, however, we must do something worth while for the average learners.

Under typical conditions, average learners show by their performances on a diagnostic test that they have mastered the unit of work fairly well, but that there are still a few spots where a need for restudy is indicated and that further experiences, designed to bring their performances to a higher level, are needed. They do such restudy as the teacher thinks necessary. Then they are given special supplementary exercises which have previously been provided for this purpose. If such exercises are not provided in the teacher's edition of the pupil's textbook, they must be prepared by the teacher. These supplementary exercises should be a little more challenging than the textbook materials previously covered, but they should be of such a nature that, with few exceptions, they can be done by the pupils independently while the teacher continues to give attention to the slower learners.

Those who excel. The most serious defect in many, if not most, school curricula is the absence of special instructional materials for those who excel. Faster learners often lose interest and fail to make satisfactory progress because the learning materials with which they are confronted are not sufficiently challenging.

Rather than provide for the acceleration of these pupils and their more rapid progress through the regular work of the school years, we suggest that they be given, at each grade level in the elementary school, the junior high school, and the senior high school, exercises similar to those which other pupils have but more challenging. These pupils should rise to higher levels of performance than can be expected of other pupils.

Special exercises for pupils who excel should be limited largely to those which develop greater degrees of mathematical insight and understanding and which lead to worth-while skills. Little space or time should be given to mere tricks or puzzles. As they work the exercises provided, the pupils should feel that they are developing understandings and skills which will be useful to them and which will result in their getting more pleasure and satisfaction out of mathematics.

Much of the work which others must do step by step with paper and pencil, these faster learners should do "mentally." Suppose, for example, that the sum of $4\frac{3}{4}$ and $2\frac{1}{2}$ is to be found. The more able pupils should develop the ability to see at once that $\frac{1}{2} = \frac{2}{4}$, that $\frac{3}{4} + \frac{2}{4} = \frac{5}{4}$, that $\frac{5}{4} = 1\frac{1}{4}$, and write the sum $7\frac{1}{4}$, in final form at once. Eventually, they should develop the ability to do even more difficult examples without writing out any of the intermediate steps. For example, if required to subtract $3\frac{2}{3}$ from $6\frac{1}{2}$, they should see at once that $\frac{1}{2} = \frac{3}{6}$ and $\frac{2}{3} = \frac{4}{6}$, that $6\frac{1}{2} = 5\frac{3}{6}$, and that the remainder is $2\frac{5}{6}$. This kind of performance requires time and practice, however, even among those who excel.

As another illustration, consider the finding of averages. All pupils learn to find the average (arithmetic mean) of a series of numbers by adding them and dividing the sum by the number of items. Faster learners might learn to find averages by using a short-cut and doing all of the work mentally. Suppose, for example that we are to find the average of the following numbers:

8 7 11 9 10 8 9 7 11 10

We guess the average to be 9. Beginning at the left, we note the extent (and direction) to which each number differs from 9 and accumulate these differences as we move across the row of numbers. We think, seeing the 8, "1 below." Then, seeing the 7, "3 below." (8 is 1 below 9 and 7 is 2 below, making a total so far of 3 below.) Continuing, we think, as we see the 11, "1 below," because the 11, which is 2 more than 9, combines with our "3 below" to make "1 below." The next number is 9 so we think again, "1 below." Continuing, we think, "even, 1 below, 1 below, 3 below, 1 below, even." The average is exactly 9.

We give another example in which the average does not come out "even." Find the average of the following numbers:

10 6 8 9 7 9 8 10

Again, we guess the average to be 9. We think as we move across the row of numbers: "1 above, 2 below, 3 below, 3 below, 5 below, 5 below, 6 below, 5 below." We are "5 below" 9 as the average. Since there are

8 numbers in the row, we are ⅝ below 9 as the average. Then the average is 8⅜, or 8.4, to the nearest tenth.

In recent years, a number of schools have included in their curricula for those who excel some exercises with numbers which are built upon bases other than ten. Attention has been given to binary numbers (base two), quinary numbers (base five), octonary numbers (base eight), duodecimal numbers (base twelve), and others. Many instances of keen interest in number systems among pupils have been reported. Scores of exercises in arithmetic, algebra, intuitive geometry, and demonstrative geometry have been reported. Some of these exercises are useful at several grade levels. The method of calculating averages which has been described has been used by many pupils at the eighth-grade level; it is also useful at other grade levels.

The "grouping-in-depth" plan has been followed successfully at elementary-school and junior high-school levels. This plan does not provide for acceleration, that is, for studying at any grade level the topics which are normally studied at a higher grade level. The "grouping-in-depth" plan may well be supplemented and followed by an acceleration plan, however. In the senior high school, it may be desirable that those who excel embark on an accelerated program. Such a program can permit the completion of a part of the regular tenth-year work in the ninth year, much of the eleventh-year work in the tenth year, and all of the twelfth-year work in the eleventh year. The twelfth-year work which is completed in the eleventh year may include advanced algebra and trigonometry and possibly other topics. The new twelfth-year program may then include analytic geometry, modern algebra, and elementary calculus. Such an accelerated program of course requires a degree of homogeneous grouping which may not be feasible in the smaller schools.

Wise Use of Materials and Devices

FOSTER E. GROSSNICKLE

MATERIALS and devices are supplementary aids to enable the student to understand his mathematics. These supplementary aids may be classified as *exploratory* and *audio-visual*.

An exploratory material is a type of aid which the student can manipulate, touch, and move. A model of a geometric solid, such as a prism or cone, is representative of this classification. Exploratory materials frequently are designated as manipulative materials. There is a vital difference between exploratory and manipulative aids. The use the student makes of the aid determines whether it is exploratory or

Foster E. Grossnickle, Jersey City State College, Jersey City, New Jersey.

manipulative. An aid, such as a model, which enables a student to discover a principle or a fact that he could not comprehend without the use of the aid is exploratory. On the other hand, an aid which is employed as a gadget used to hold the attention of the class because of its moving parts or of some other characteristic is a manipulative material. An aid of this kind does not increase the student's ability to develop understanding of and insight into number relationships, hence it is a manipulative aid or a gadget.

Visual aids consist of pictures, posters, charts, films, filmstrips, or other types of projective materials.

All exploratory materials are supplementary aids because they are not included in the textbook. Similarly, films, filmstrips, and other projected materials also are classified as supplementary materials. Pictures and diagrams may be supplementary to the textbook or they may be included in the text as an integrated part of the symbolic material of the text. All printed material that is expressed in words or symbols may be classified as *symbolic material.*

The purpose of supplementary aids is to enable the student to interpret symbolic materials. Learning mathematics is a growth process which consists of mastering successively higher levels of abstraction. The level at which the student is able to operate determines whether or not he needs to use supplementary aids.

A student may use cubic blocks, such as 1-inch cubes to form a 2-inch cube, a 3-inch cube, or a 4-inch cube. He counts the number of 1-inch cubes used in forming each of the large cubes. He then discovers that each of these numbers, in turn, is equal to the cube of the number of 1-inch blocks placed along the edge of each cube. By this procedure he discovers the rule for finding the volume of a cube. If he does not discover the rule, he verifies the rule by counting the number of the blocks. Another student may be able to discover the rule or the verification of it from a diagram showing the structure of a 2-inch or a 3-inch cube. The level of abstraction at which the student begins the study of finding the volume of a cube depends upon his background. The student who is quick to discover number relationships and has the ability to interpret a drawing so as to visualize a solid may be able to discover the rule for finding the volume of a cube by a careful analysis of the drawing. On the other hand, the student who does not have the ability to visualize spacial relationships should use cubic blocks to discover the meaning of the formula for finding the volume of a cube. In each case, the use of blocks or the study of a diagram is an instructional aid needed to help the student in understanding the work dealing with symbols.

The exploratory work dealing with supplementary aids always precedes the work given in the textbook. Working with these aids represents a lower level of abstraction than working with symbolic materials. The function of these aids is to enable the student to acquire readiness for the study of the textbook. A student does not understand mathematics

until he can operate successfully with symbolic materials, such as are found in a textbook in that subject.

The teacher may make one of two serious errors of procedure in introducing new work. The work may be geared at a level too high for the student to understand the explanation or the work may be set at such a low level of abstraction that it does not challenge the student. In the first instance, the teacher may introduce from the textbook a new topic, such as finding the area of a triangle. The student may understand the development, if supplemented by a diagram. However, he may not understand the presentation. If the student would cut two equal triangles from paper and place them so as to form a rectangle or a parallelogram, in all probability he would understand the presentation given in the textbook. On the other hand, if this student has no supplementary work to provide readiness which would enable him to interpret the symbolic presentation, he must learn the rule for finding the area of a triangle by rote. Then the work becomes meaningless. In presenting the work, the teacher began the explanation at the level of abstraction beyond the comprehension of the student.

The second error of procedure results from under-estimating the level at which the student can succeed. In such a case, the teacher may have the student cutting out triangles and placing them so as to form a rectangle or some other parallelogram. By this procedure, the student would discover the relationship between finding the area of a triangle and finding the area of a parallelogram when bases and altitudes are equal. This student may understand the treatment given in the textbook, but he is not challenged by working at this immature level of operation. The paper cutting activity bores him and he shows no interest in the work. The student who can interpret, understand, and explain the development given in a text should not be required to operate with these supplementary aids. These materials are the essential means for success for the student who lacks the insight of the more capable student in mathematics.

There is no rule which the teacher can follow to avoid the two errors of procedure described. Good teaching demands that the student must be challenged to operate at the highest level of abstraction at which he can understand and succeed in the work. On the whole, a safe procedure to follow is to have the class begin a new topic, such as finding the area of a triangle, by using exploratory materials.

The same principles which apply to provision for individual differences apply to the use of supplementary aids. Some students require more directed learning activities than others to operate at successively higher levels of abstraction. The supplementary aids are effective means used in enabling the student to work at higher levels of abstraction until he is able to understand the work given in the textbook. There are few students who cannot enrich their understanding of a new principle or process by

using some form of supplementary aid. The great difference in the use of these aids consists in the time a student should devote to them. The fast learner should spend a minimum of time using exploratory aids. The less capable learner should be permitted to operate with aids until he understands the work and can succeed with confidence in dealing with symbolic materials.

Evaluation of Student Learning in Secondary School

JOHN J. KINSELLA

MORE than one teacher of mathematics has asked himself what he would like his own children to get out of their experience with high-school mathematics. In the course of the monologue he may have given his "alter ego" some answers like these:

They should gain in their *understanding* of mathematical principles and methods.

They should augment their *skill in performing* mathematical operations and processes.

They should increase their *ability to use*, in situations outside of the mathematics classroom, the mathematical understandings and skills they have acquired.

They should come to *enjoy more* the activities involved in experiencing mathematics and look forward with zest to more contact with mathematics.

They should grow in their control of the *strategy of learning* mathematics. In other words, they should become more effective in the study of mathematics.

These are ambitious goals. How could our conscientious teacher find out to what extent these five kinds of desirable changes were taking place in his class of 30 or so? What kind of evidence should he collect? How should he gather it? What should he do with it? In brief, how should he *evaluate* the learning of his students?

It has been said that teaching is an art. If too much time and effort are given to evaluation, the imbalance could well undermine the teaching function. The various activities that constitute the teaching of mathematics must be blended in a way that leads to the most effective accomplishment of all of the five aims listed above.

The attitudes of principals and department heads toward evaluating more than performance are bound to influence what the teacher of mathematics does about other aspects of evaluation. If the marks on report cards are to reflect, by administrative edict, only the success of the students in passing tests of factoring, the solving of equations, the proving

John J. Kinsella, School of Education, New York University, New York City.

of type "originals" and recalled theorems, then it is likely that classroom evaluation will be limited to these aspects of mathematical learning. It should be added that nearly all standardized tests are also limited to appraising these skills and the ability to recall stereotyped models of mathematical performing.

If we start with the axiom that there is always something good in the other person and what he does, then it would seem to follow that the elementary-school teacher and the high-school teacher could profit from an examination of what each other does in evaluating the learning of mathematics. During the past 15-20 years, the teacher of arithmetic in the elementary school has been pressed to teach with an emphasis on "meaning and understanding." To evaluate the pupils growth in grasp of concepts and principles, this teacher has had to ask questions in class and on tests that were designed to appraise more than just operational performance.

What does each "2" in 222 mean? Why do you indent the partial products in multiplying 234 by 567? In changing $2\frac{3}{8}$ to an improper fraction, why do you multiply 2 by 8 and add 3 to obtain the numerator of the desired fraction instead of multiplying 2 by 3 and adding 8? In dividing $\frac{3}{4}$ by $\frac{5}{16}$, why do you invert the second fraction and not the first? In obtaining the product of 3.24 and 1.6, why do you determine the number of decimal places in the product by adding the corresponding number of places in the two numbers being multiplied? It is obvious that questions like these cannot be answered by the skillful manipulator alone. It seems likely that a little more attention to understanding, implied by these sample questions, would have a tendency to reduce some of the absurd juggling of numbers exhibited by some students.

Questions framed to evaluate understanding can be asked in the algebra class, too. For example, in multiplying a^3 by a^2 why don't you multiply the exponents instead of adding them? How does the distributive law of multiplication with respect to addition justify the statement that $3b + 2b = 5b$; that the factors of $6c^2 + 2c$ are $2c$ and $3c^2 + 1$; that the sum of $\frac{d}{m} + \frac{h}{m}$ is $\frac{1}{m}(d + h)$, or $\frac{d+h}{m}$; that $7\sqrt{5} + 2\sqrt{5} = (7 + 2)\sqrt{5}$, or $9\sqrt{5}$? Is every equation, a true statement? If so, what about $2a + 3 = 5a - 3a + 4$? If $\frac{8t}{2} = 4t$, why doesn't $\frac{8 + t}{2} = 4 + t$?

The primary aim in the teaching of plane geometry is to develop an understanding of the structure of mathematical proof; a secondary purpose is to extend and make more precise certain geometric concepts and to give the student experience in applying important geometric relationships expressed by theorems to a variety of configurations. In evaluating the attainment of these objectives, the teacher might ask questions like these: What is the plan of this proof? Show me how you can use the

analytic method to discover the sequence of steps needed to prove that the diagonals of a parallelogram bisect each other. If we changed the definition of a parallelogram to a "quadrilateral whose opposite sides are equal," could we prove all of the other important relationships? If we did not assume that every angle has a bisector, could we still find a way of proving that the base angles of an isosceles triangle are equal? Can we find a way of proving that the area of a triangle $= \frac{1}{2}$ ba without first proving that the area of a parallelogram $=$ ba? Can we use the geometric type of proof to show that the product of even integers is an even integer, and that the tangent ratio of an angle equals the sine of the angle divided by its cosine?

The philosophy of elementary-school teaching includes the belief that what is taught should be "functional." The elementary-school teacher in line with this tenet has appraised the pupil's use of mathematics in construction projects, in determining distances from maps, in planning the cost of parties and trips, in measuring the diet requirements of class pets, and in estimating sizes and amounts in science projects. Written descriptions of observations have been made; anecdotal records have been kept.

It is much more difficult for the high-school teacher to evaluate uses of mathematics. He may meet 150 students per day instead of 30. The average amount of time he has available for observing each student is about two minutes per day. He is expected to deal with one "subject" only; the opportunity for relating to other "subjects" and activities is scant. However, he can work with the science and shop teachers, for example, in checking on his students' ability to apply mathematics. Can they measure accurately? Can they construct plans with geometric instruments? Can they interpret and use formulas in general science and physics? In social studies classes, can they read and interpret data in graphs and tables? How competent are they in using decimals and ratio and proportion in chemistry?

To evaluate the ability of his students to apply mathematics in his own classes, the teacher can find material by asking his fellow teachers what kinds of mathematics his students need in their classes; by having his students bring to class magazine and newspaper clippings showing uses of mathematics; by asking them to find out from their parents what uses of mathematics are involved in earning a living.

The play atmosphere is more common in the elementary than in the high school because the pupils are younger. With play, enjoyment is usually associated. The elementary-school teacher observes that some pupils get unusual enjoyment out of playing with numbers and geometric forms. The teacher watches for detestation of certain topics in arithmetic; she is alert to feelings of frustration as well as to feelings of liking and success. The good high-school mathematics teacher can, to some extent, do likewise. He can evaluate his success in encouraging enjoyment of

mathematics and lessening the causes of dislike and fear. Aware that there is "no royal road" to success in mathematics, he occasionally inserts recreational types of mathematics, uses "challenges" often, and praises the less able for their minor successes.

Finally, the good high-school teacher provides occasional opportunities for the student to teach himself mathematics by reading ahead in the textbook and by studying other books and materials. He teaches his students how to read problems in algebra and how to use illustrative material in the textbook to "get the idea." He devises reading tests of mathematical material and appraises his students' growth in succeeding with them. As the teacher extends and deepens his evaluative procedures he usually finds that both his teaching and the quality of learning improve.

Evaluation of Learning in Arithmetic

LAURA K. EADS

EVALUATION, curriculum, instruction, supervision, teacher training, and learning in arithmetic are so closely interrelated that consideration of any one of these necessarily involves all of the others. What pupils learn in school is largely determined by what teachers and parents really hold to be of value. Where quantity and speed of learning in arithmetic are of primary importance, pupils will gain approbation for uncritical memoriter-type learning (because of quick, albeit temporary, "results"). Few pupils will then attach importance to discovering mathematical relationships, thinking out solutions in original ways, computing "mentally" whenever possible, making estimates before written computation, *etc.* Teachers too reflect the values of *their* teachers or supervisors. Where instruction is viewed in terms of pupil performance on tests administered centrally, teachers will emphasize speed and accuracy on paper-and-pencil tests and will try to bring all pupils (particularly the slow) "up to the grade norm." Few teachers will then attach importance to activities planned to teach mathematical meanings or designed to encourage *all* pupils to do mathematical thinking at their respective levels of ability. (These are too time consuming.) Present-day pressures on administrators and supervisers to "speed up" the process of learning in arithmetic may very well result in even more "pseudo-learning."

Goals or objectives stated in a course of study for a school system may or may not be those accepted by the teachers and supervisors in that system. Where teachers and supervisors are involved in curriculum building, the stated goals are likely to reflect those that teachers and supervisors can accept as their own.

Laura K. Eads, Bureau of Curriculum Research, New York City Public Schools, New York.

The methods that teachers in a particular school use for evaluating the growth of their pupils in arithmetic tell us a great deal about their teaching goals, as well as about the goals of the head of that school. For example, a school system has developed a course of study in arithmetic emphasizing a developmental and meaningful approach. In School A, the teachers see evaluation solely as a means of marking or grading pupils. These teachers test periodically, indicating each response as either all-right or all-wrong. All pupils are expected to follow the same method in finding a solution. Pupil thinking, originality, and initiative are not valued in these classes.

In School B, however, the teachers interpret evaluation as an intrinsic part of everyday teaching. These teachers encourage mathematical thinking and independence in many ways. They provide time for pupils to make and to use materials which will help them understand mathematical structures and principles. Then they observe the pupils as they use materials in order to evaluate their understanding of mathematical principles, and to find out when they may be ready to do mathematical thinking without referring to these materials. Each day they find out which pupils are able to find solutions in new ways. They ask pupils to explain their own methods, or the methods other pupils may have used. They ask pupils to give other examples of these new solutions. These teachers indicate that they see teaching as including observation of pupil activities, listening to and evaluating pupil explanations, finding out how different pupils think, finding out which pupils can build on other pupils' solutions, *etc.*

The way the administration in a school or school system plans and conducts school-wide or system-wide testing programs influences teacher goals. Often, teachers interpret such programs as designed to evaluate them and their teaching competence. In such cases they adjust their instruction so that their pupils will score as high as possible on the day such tests are administered. If tests of computation are to be administered, teachers assign endless drill and practice exercises, regardless of the negative attitudes toward mathematics the pupils may be developing. If tests of verbal "problems" are to be administered, teachers assign exercises emphasizing the "reading of problems," looking for cues and clues, *etc.* This is done at the expense of having pupils engage in significant experiences, and of encouraging pupils to think out *mathematical* relationships.

A principal in a large city instructed his teachers to help their pupils "get high standardized test scores in problem solving" as follows. Tell pupils that if the problem has more than two numbers about the same size, they should add. If the problem has two numbers about the same size, pupils should subtract. If the problem has two numbers, one much larger than the other, pupils should divide; if it comes out even, then all right. If it doesn't come out even, pupils should then multiply. This prin-

cipal revealed that he saw teaching in arithmetic as a set of tricks to "fool" the authorities. Unfortunately, he undoubtedly convinced at least some of the teachers in his school that this was an expedient goal.

Following are some practical suggestions for evaluating pupil learning in arithmetic. A school principal may help teachers incorporate suggestions such as these as part of their day-by-day teaching.

1. Pupils develop concepts over an extended period of time. Make no assumptions regarding what is being learned or what has been learned heretofore. Plan for mathematical experiences which will foster continuous growth in concept development, and which will provide opportunities for continuous evaluation of such growth.

2. In developing a lesson or series of lessons, start with steps developed some time ago. This provides an opportunity to evaluate the learning of less mature pupils. In proceeding with more advanced steps, the learning of pupils at progressively higher levels of maturity may be evaluated.

3. Pose *thinking* or *problem* situations. Find out how pupils at varying levels of maturity think out solutions. Expect more precise mathematical language from mature pupils than from the less mature.

4. Plan to find out whether pupils understand mathematical principles. Evaluate also pupil ability to apply such principles to topics not yet developed. Expect mature pupils to see more relationships, and to make applications more readily than the less mature. Be particularly alert for pupils who may be repeating definitions, stating principles, or verbalizing generalizations without understanding. When in doubt, ask pupils to demonstrate using materials or referring to diagrams, or to "tell it using other words."

5. Differentiate between testing facts and drill on facts. Random presentation of unrelated facts should be considered testing, rather than drill or teaching; the pupil gets no help—he either knows or does not know the fact presented. For teaching or drill, facts should be presented within a system of relationships, so that the pupil will learn the facts not in isolation but as part of a mathematical structure, system of axioms, principle, *etc.*

The procedures for evaluating pupil learning briefly discussed here are particularly applicable to teaching at the elementary-school levels. With some minor modifications, these are also applicable to teaching in most upper classes.

Articulating Geometry Between the Elementary and Secondary Schools

ANN C. PETERS

WE ARE surrounded in our material world with numerous occasions to deal with magnitude measuring how much and quantity indicating how many. These two ever-prevailing questions prompted man in his development through the ages to invent a number system to cope with these matters. The material world around us also reveals form as clearly as it suggests number. Nature and man's work present form in an endless variety of shapes. Certain of these have a tendency to reappear constantly. Hence our concern for the development of ideas, vocabulary, and skills related to the informal geometry of shape, size, and position and then, later, as these relate to formal geometry. The informal approach is dependent upon experimentation, intuition, discovery, and practicality. The formal approach is demonstrative, relying on deductive reasoning and has a body of knowledge advantageous to engineering, industrial design, and construction. It also has a body of knowledge to appreciate for its own sake. Intuitive geometry is fundamental in the geometry program of the elementary and junior high school and it must be transferred into more mature applications in the senior high school.

Kinds of Articulation

A significant problem in articulation of mathematics as well as a barrier to individual progress is the student's inability to handle tasks expected of him. This is true particularly on the secondary level where there may be a considerable backlog of unlearned concepts. If articulation in the long chain of geometric learning is expected to provide a stage-by-stage growth, then it seems plausible that, if these be a bridge in the articulation of geometric ideas, perhaps it is in the junior high school where the link with the past and the future is most in evidence.

Good teaching and learning is developmental. Good mathematics is readily learned and all levels become significant in that each contributes progressively to the continuity of mathematical ideas. Continuous learning, then, may be viewed as vertical articulation. But there is another aspect to mathematical articulation which is nearly as significant as the vertical. It is very early evidenced that arithmetic and geometry reinforce each other and, eventually, algebra adds to the enhancement of all three areas.

Thus, vertical and horizontal articulation restrains psychological discontinuity such as "cut offs," "breaks," and "bridging the gaps." Articulation which has depth and width provides the much needed holding power in mathematics rather than the discouraging experience of bridging gaps

Ann C. Peters, Keene Teachers College, Keene, New Hampshire.

and mending breaks which has been the consequence for many students in geometry.

Geometry in Our Schools

What should the junior high-school teacher of mathematics expect of his pupils regarding geometry? An examination of several courses of study, college texts in mathematics for the elementary teacher, as well as pupil's arithmetic textbooks, reveals geometric form is introduced as early as the kindergarten where "the wheel is round" and "a box has corners, sides, a bottom and, perhaps, a top."

In a typical textbook series, pupils meet in the primary grades colorfully labeled squares, circles, rectangles, and triangles. As fourth-grade pupils, they are introduced to right angles and parallel lines. All these geometric forms are repeated in attractive designs on Indian tepees. Framing a 3′ x 4′ class-made map of the local area provides a realistic setting in the fifth-grade book for developing the ideas of "dimensions" and "perimeter." An entire unit evolves the concept of one square foot, one square inch, and one square yard and their use to determine areas of rectangular and square figures. In the sixth-grade text consideration is given to reading floor plans, finding perimeters and areas, scale drawings, using square rods, acres, and square miles to determine areas, finding volume of rectangular solids, and using ratio to enlarge pictures.

Thus in a brief scanning of a program from the primary grades through the sixth grade one observes its sequential nature. There is vertical articulation between geometry and arithmetic. But there is no articulation with algebra.

What Geometry for the Junior High School?

If the junior high school links the past with the future, then smooth articulation avoids both gaps and extensive repetition at this stage. Teacher-made tests can readily locate special cases requiring help as well as those ready for advanced work. Another matter of professional significance emerges at the junior high-school level. Prior to this, the now preadolescent child was taught mainly by teachers whose professional training strongly emphasized the developmental and pragmatic approach to learning, though they themselves prossessed a meager understanding of mathematics. On the other hand, from grade seven until graduation his mathematics, as other areas, will be departmentalized and taught by teachers who supposedly have majored or minored in the subject. If good articulation is essential to good learning in geometry, then this "natural bridge," the junior high school, must be fortified with master strategists who recognize the learner as well as that which must be learned in order to cope with the next level of geometric insight.

By intent the junior high school should be exploratory and provide for further developmental work in areas and volumes concluding with

algebraic generalizations, better known as formulas. Furthermore, the compass and protractor assist in making designs, constructions, bisections, and measuring angles. All types of triangles as well as their angles and sides are studied, but the right triangle gets special consideration in finding the hypotenuse as well as utilizing the tangent ratio to determine a missing distance. Similar triangles, too, because the ratios of corresponding sides are equal, provide a means for indirect measurement. More might be done in the junior high school with the imaginative treatment of geometric ideas. Pupils on the whole, are unfettered, free, pliable, and elastic mentally and seek the opportunity to use their agile minds on the whimsical, yet logical, such as *Geometry in Paper Folding*[1], *Flatland*[2] and *Fourth Dimension*[3] as well as good space fiction and the historical treatment of geometry.

To improve articulation let there be a gradual shift from the informal approach of the grade school to more mature and abstract deductions with an appreciation, always, for what has been taught previously. Let there be continued emphasis upon the development of understandings, even on the early secondary level, building upon the foundation the youth has now, bearing in mind he is not yet able to function competently—this job belongs to the senior high school and the college.

To articulate the geometry program for pupils implies there should be nothing less for teachers. If vertical and horizontal articulation is desirable for successful learning, then it seems reasonable that teachers and supervisors of mathematics should organize into vertical curriculum committees. While it is unrealistic for all elementary teachers to be members of such a group, some might be selected, invited, or admitted because of a special interest in mathematics and thus serve as a communication channel between two usually diverse groups. The school's role, then, in articulating geometry would be to link experiences and dove-tail intellectual insights, so that, as the human mind develops, it can take the next step of moving from the obvious, factual, and imaginative to deductive proof or, demonstrative geometry, with a glacial like movement—slowly, surely, and smoothly.

---

[1]Row, T. S. *Geometric Exercises in Paper Folding*. London: Open Court Publishing Co. 47 Monmouth St. 1941.

[2]Abbott, E. A. *Flatland*. New York: Dover Publications, 1952.

[3]Manning, H. P. *Fourth Dimension*. 347 Fifth Ave., New York: Peter Smith.

Evaluation in Arithmetic and Talented Students

VINCENT J. GLENNON

THIS title implies that the first three difficult educational problems associated with talented students—the identification of, the objectives for, and the teaching of—have been solved, leaving for this article a brief discussion of the fourth problem—the evaluation of growth along the lines of the previously agreed upon objectives. These previously agreed upon objectives, whether for the talented, the average, or the slow, fall into three categories or domains that have been identified as the cognitive domain, the affective domain, and the psychomotor domain.[1]

The cognitive domain is the subject matter domain and includes the three kinds of verbal learnings—understandings, concepts, and arbitrary associations (facts). The affective domain is the domain of emotional learnings and includes attitudes, appreciations, and feelings. And the psychomotor domain, the mind-body domain, includes mental skills, motor skills, and habits.

In the brief space allowed to this article I will limit this discussion of the evaluation of the learning of talented students to the cognitive domain; that is, to the learnings that take place *in* arithmetic. We recognize, of course, that the learnings that take place *through* arithmetic instruction, the so-called intangibles, are also important to teach for and to evaluate for.

We can save an extended discussion here by saying immediately that the standardized test is useful to some extent in the evaluation of growth by talented students in computational skill and verbal problem solving ability. It is of little usefulness in the evaluation of growth in such important areas as insight into number relationships, basic mathematical meanings, knowledge and rationale of the symbolic representation used for number systems with bases other than ten, maturity of thought processes, and depth of understanding—to mention just a few.

Assuming for the moment then that the teacher is already making prudent use of presently available tests of computational skills and verbal problem solving ability, the remainder of this article will be devoted to a discussion of a more penetrating approach to the gathering of pupil responses upon which to make an evaluative judgment of the arithmetic ability of the talented student.[2] It need hardly be said that the broader approach to evaluation techniques being used today, including such as the anecdotal record, sociodrama, play therapy, the observation and inter-

[1] *Taxonomy of Educational Objectives—Handbook I: Cognitive Domain.* Benjamin S. Bloom, editor. New York: Longmans, Green and Co. 1956. 207 p.

[2] For a more detailed discussion of the characteristics of children who are highly talented in arithmetic, the reader may wish to consult the *second edition* of *What Does Research Say About Arithmetic?* published by the Association for Supervision and Curriculum Development, 1201 Sixteenth St., N.W., Washington 6, D. C. (late 1958).

Vincent J. Glennon, School of Education, Syracuse University, Syracuse, New York.

view, and others, is as useful with the average and the slow as with the talented.

The most penetrating evaluation technique available to the teacher is the observation-interview. It is generally agreed that this is the only technique that enables the teacher to get at the thought processes being used by the learner. Its use assumes that the teacher is attempting to provide for depth, maturity, or quality of learning. So let us look at two learning situations to see how the observation-interview technique might be used by the teacher.

Assume that a fourth-grade group of pupils is concerned with the problem of sharing equally 154 marbles among 7 boys. Also assume they have no previously learned mature solution to the problem. During the learning process, the teacher is observing and asking questions to gather evidence of maturity of the learning. He might witness such as these:

A pupil of average mental ability begins by counting out 154 tongue-depressers. Then taking a group of 7, he places one in each of seven boxes—each box standing for a boy. Then he counts away another 7 which he also shares equally among the 7 boxes. He continues this until there are either zero tongue-depressers left or not enough to share equally among the 7 boxes. His answer is the number of tongue-depressers (marbles) in any one box.

Observing this performance the teacher would conclude that the pupil worked slowly and accurately, but on an immature level. This is not the performance of a talented pupil.

An above average pupil might also use the counting method, but show 154 as 15 bundles with 10 in each bundle and 4 singles. He would count away 7 tens, placing 1 ten in each of the 7 boxes. Then he would count away 7 more tens, leaving 1 ten and 4 ones. Showing the 1 ten and 4 ones, he would distribute them equally. Obviously this is a much more mature level of behavior than that of the pupil described above.

Now observing and interviewing the talented pupil, the teacher might see him demonstrate a high level of insight. He might go immediately to the level of symbolic representation of numbers thinking and writing "Each boy will get $\frac{1}{7}$ of the 154 marbles. So, $\frac{1}{7}$ of 14 tens is 2 tens, or 20. $\frac{1}{7}$ of 14 ones is 2 ones. Each boy will get 22 marbles. Such a performance, when there has been no previously learned solution, should be evidence to the teacher that this is the thinking of a talented student.

Now let us look briefly at the maturity or depth of performance level of the talented student on the seventh- or eighth-grade level. While the average student is continuing in his attempt to master the decimal system and its applications to business practices as found in a typical arithmetic textbook, the talented student should be taking many side-trips for the purpose of both extending previous learnings and enriching his background with wholly new learnings. Evidence of the degree to which he is achieving these two objectives will be gathered by the teacher through observation and interview.

Having taught, let us say, the use of the two symbols 0 and 1 to represent numbers from 1 to 16 (1 to 10,000) the teacher could evaluate the depth of learning of the student by asking him to extend his learning to the writing of the numbers to 32 or to 64.

On a still higher level the teacher could gather evidence of the student's power by asking such questions as:

How many digits will be needed to represent the decimal number 83 in the binary system?
What decimal number has the value of the binary number 1,011,010?
Change to binary numerals and add: $43 + 76 + 29 = ?$
Using binary numerals, find the product of 18×61.
Change to binary numerals and add: $\frac{1}{2} + \frac{2}{3} = ?$
Show as decimals in the binary system and add: $3.25 + 4.5 = ?$

In summary, this brief article has attempted to show that the evaluation in arithmetic of the work of talented students makes use of the same tests, the same techniques, and the same procedures that are used with average students. The difference resides not in *how* we evaluate the talented student but *what* we evaluate for; namely, increasingly more difficult mathematical ideas.

Are We Sure Learning Has Taken Place?

E. GLENADINE GIBB

HOW DO we know that learning has taken place? What ways do we have for observing this activity? What confidence can we place in our observations? These are some of the questions we raise in attempting to answer the question, *"Are We Sure Learning Has Taken Place?"*

What Is Learning

Let us first consider briefly the nature of learning. This may enable us better to determine whether or not learning has occurred. Learning is commonly defined as a change in behavior. It is the process by which the learner becomes able to respond more adequately to a given situation as the result of experience in responding to similar situations. Two familiar kinds of learning are (1) learning by rote, and (2) learning by understanding.

Learning by Memorization. For learning to take place by rote, the learner is given elements of learning which are to be repeated several times and mastered. By this process the repetition of an element of learning does not create and does not reveal any structured relationship be-

E. Glenadine Gibb, Department of Mathematics, Iowa State Teachers College, Cedar Falls, Iowa.

tween several elements to be learned. A pupil may learn that $4 + 3 = 7$ but he sees no relationship between that and the fact that $5 + 2 = 7$. Or, a student may learn that, if $ax^2 + bx + c = 0$, then $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ This kind of memorization is not to be confused with the learning which is a combination of both understanding and memorization—learning which gives a student his knowledge of number facts and names of mathematical terms as factor, product, per cent, exponent, point, line, polygon.

Learning by Understanding. For learning to take place by understanding, the learner listens to the description of the element to be learned in terms of one or more examples. He tests hypotheses regarding the element to be learned. In so doing, there is established an interrelation between the material, the operation, and the performance. He gains insight into the relationship between the performance and the example from which the elements are to be learned. The process of understanding by means of reorganizing the material yields something which is not identical with learning the words which were taught. Learning by understanding involves substantially problem solving—the discovery of a principle.

Then, learning mathematics by memorization implies that, if the learner can repeat rules, give facts, and/or is able to use these rules and facts in solving exercises, learning has undoubtedly taken place. Learning mathematics by understanding means that the learner is able to make discoveries, abstractions, and generalizations, and relate these in a logical organization. An attempt to observe if learning has taken place is to discover whether or not learned behavior has been sufficiently generalized to be activated by a different but similar stimulus.

Measures of Learning

It is a common practice to determine if learning has taken place by observing performance. Learning then becomes an inference from performance. This can be dangerous for it is easy to equate learning and performance. Yet, there may be learning and zero performance. Many people, accomplished in their fields of endeavor, are known to have made on occasion a poor performance. Furthermore, tests and observations are not valid unless they check on the behavior the learner was intended to develop. They must reveal what the student will do in the sort of situation he supposedly has learned to respond to and in the manner in which the learning was done.

A common measure of performance has been that of *percentage frequency.* One of these techniques is based on the number of runs. A *run* is defined as a succession of identical symbols which are followed and preceded by different symbols or no symbols at all. For example, suppose a series of S-F scores (success-failure) occurred in the following order:

S	F	F	F	S	S	F	F	S	F	F	S	S	S	S	S	F	S	S	S	S	S	S	S	S	S
1		2		3		4		5	6			7				8					9				

We observe that there are 9 runs. We can then test the null hypothesis that the successes and failures occur in random order. There are 18 S's and 8 F's. Referring to appropriate tables for $r = 9$, $n_1 = 18$, and $n_2 = 8$, we find that r must be smaller than 7 or greater than 17. Consequently, we would have no reason to assume that learning had as yet taken place. This technique is particularly important when the response could be expected to be, in part, a chance response (4,5). The statistical requirements are rather rigid in this respect. Even a large run of "correct" responses may be meaningless if such a run occurs after a very long run of "incorrect" chance responses. *Runs* and grouping of *successes* and *failures* as criteria of learning in a properly controlled study of learning or problem-solving permit the experimenter in the laboratory or the teacher in the classroom to conclude that the learning has or has not taken place.

There are those who assume that there is some sort of physiological limit beyond which learning cannot improve (1). They note that learning proceeds by increments—at first large and then becoming smaller and smaller and presumably continues indefinitely with successive reinforcements. Plotting the scores from learning experiences in the form of *performance curves* also has proved serviceable in determining if learning is taking place. Having plotted the results of learning in a form that shows some regularity of curvature, it is possible to fit a mathematical function to the points. Among the many attempts to fit curves to learning data, several have proposed functions that have two parameters, one representing the upper limit of learning, the other representing the rate at which the limit is approached (6:561-562). Not only does this enable us to define individual differences in learning, but also to make inferences about the zero point in learning and about the upper limit in learning.

Concluding Remark

It is possible to observe with a degree of confidence that learning has taken place, whether it be learning by rote or learning by understanding. Certainly a fundamental problem in this measurement of learning is *what* to measure. Runs of correct responses, grouping of successes and failures, and performance curves are criteria of learning which seem worthy of consideration in helping us to answer our question, "Are We Sure Learning Has Taken Place?"

References

1. Bugelshi, B. R. *The Psychology of Learning.* New York: Henry Holt and Company, 1956. Pp. 162-198.
2. Deese, James. *The Psychology of Learning.* New York: McGraw-Hill Book Company. 1952. P. 398.
3. Fehr, Howard F. "Theories of Learning Related to the Field of Mathematics." *The Learning of Mathematics, Its Theory and*

Practice. Twenty-first Yearbook. Washington, D. C.: The National Council of Teachers of Mathematics. 1953. Pp. 1-41.

4. Grant, D. A. "New Statistical Criteria for Learning and Problem Solution in Experiments Involving Repeated Trials." *Psychological Bulletin,* 43. 1946. Pp. 272-282.
5. Grant, D. A. "Additional Tables of the Probability of 'Runs' of Correct Responses in Learning and Problem-Solving." *Psychological Bulletin,* 44.. 1947. Pp. 276-279.
6. Hilgard, Ernest P. "Methods and Procedures in the Study of Learning." *Handbook of Experimental Psychology,* edited by S. S. Stevens. New York: John Wiley and Sons, Inc. 1951. Pp. 517-567.

Chapter V

Mathematics and Educational Television

The Production and Presentation of a Televised Mathematics Program

JOSEPH R. HOOTEN, JR.

THE production of a televised mathematics program is a complex procedure. It is not sufficient merely to place a capable classroom teacher, chalk in hand, before a television camera and instruct him to "teach the unseen classroom." Rather, a mathematics program requires long and arduous hours of planning and preparation, involving the participation of a number of people. This is not to say that the effective teaching or promotion of mathematics cannot be done *via* television. It is to say that such teaching or promotion requires careful consideration of the factors involved before the program goes on the air.

Mathematics is a discipline which has an underlying structure based on axioms, definitions, and theorems. Upon this foundation, the mathematician builds his science using the processes of reason. It is not an easy task to become knowledgeable in mathematics. One must resort to intuition, logic, insights, or just plain hard work. But it is just this hard work, this invoking of reason, this structure, that makes the subject exciting; yes, even "fun." Any televised mathematics program must reflect the nature of mathematics not just the end products.

Television possesses elements possible in no other medium of mass communication. These elements can be summed by calling attention to the fact that television is both aural and visual. Furthermore, unlike the motion picture, television has the added advantage of immediacy. Hence, any televised mathematics program should take advantage of these elements. Most television producers agree that the program with the lowest audience appeal is a filmed speech, in which seeing the speaker is not essential to the communication.

So then, the problem of producing a televised mathematics program, be it for instructional purposes or for promotional, is the problem of presenting mathematics in an aural and visual setting in such a manner as to establish an effective communication. Perhaps the following criteria will suggest some ways in which this can be done.

Joseph R. Hooten, Jr., School of Education, Florida State University, Talahassee, Florida.

Criterion I. *A televised mathematics program must have a clearly defined objective. The primary objective of a promotional program is to change opinions or to cause some action to take place. The primary objective of an instructional program is to teach certain concepts and skills in mathematics or to change attitudes about mathematics.*

Perhaps the desired action to result from a promotional program could be as simple as attendance at a science fair to view the mathematical exhibits. It could be as complex as increasing a favorable vote on a local bond issue that will eventually lead to more qualified mathematics teachers in the local school.

If the objective is to improve skills in mathematics in an instructional televised program, the specific skills must be chosen with care. While it may be possible to teach one way of finding the solution set of a system of equations in a single half-hour program, it does not seem reasonable that three methods can be taught in the same length of time. It is far better to select one skill and demonstrate it thoroughly than to select more and risk accomplishing nothing.

Criterion II. *The content of a televised mathematics program must involve correct and significant mathematics which will arouse thoughtful activity on the part of the viewer.*

The accent here must be on the correctness of the mathematics. It is not enough that the performer makes no errors in calculations. The mathematics must be impeccably accurate. No mathematics teacher would ever say to a class, "The area of a triangle is equal to the product of the base times the altitude," for the error is patent. However, errors of a more subtle nature may be more difficult to avoid. Therefore, this criterion has implicit in it the notion that a good television program about mathematics is one produced from a carefully written script which has been read by other mathematics educators. In this manner only can freedom from error be assured.

Criterion III. *The intended audience must be identified in terms of the age range and the mathematical maturity of its members.*

In defining an audience for the purpose of planning the production of a televised mathematics program, it is probably best to think of a hypothetical individual who typifies the composition of the intended audience. The audience for closed-circuit television is usually small and specific and can be easily identified. The open-circuit broadcast television program seeks a similar specific grouping within a generalized audience.

Criterion IV. *The suitability for its intended audience of a televised mathematics program is gauged by the appropriateness of the content of the program and the language used. In all cases, the language must be accurate.*

It seems almost unnecessary to repeat the admonition: "The content must be suited to the audience." However, this is a common fault of many

programs that are being presented today. In some instances, the vocabulary and the concepts are far above the ability of the majority of the audience to comprehend and, consequently, general acceptability of the programs is lowered. In the same vein, some programs are guilty of using a vocabulary and concept content that is an insult to the intelligence of the intended audience. The content must accomplish the two-fold task of suiting the specific viewer while containing enough provocative material to stimulate the largest possible audience to further thoughtful activity.

Criterion V. *The nature of television implies that the concepts involved in a televised mathematics program must be suited to visualization, that the settings enhance the educational value, that a feeling of movement be imparted.*

In any learning situation, the acquisition of an abstract concept properly begins with concrete illustrations. In mathematics learning this is particularly appropriate. These illustrations can be static, such as a diagram, or they can be dynamic, such as a flexible polygon. In any event, "see" is perhaps one of the most frequently used words in the vocabulary of the educator. If seeing and hearing are important to the audience acceptability of the proposed program, then it is probably suited to television.

However, the television screen and camera are limited in what they can see at any given moment. It is easy to overcrowd a camera shot and thus present a confusing picture. Care must be taken not to sacrifice the valuable asset of focal power, by asking for too much focalization at any one time.

In judging sets to be used on a given television show, two questions must be answered. *One*, are the sets in keeping with the nature of the program, enhancing the educational effect? *Two*, can they be constructed with a minimum amount of time and expense?

By a judicious use of cameras, film-clips, and slides, a feeling of movement can be imparted to the viewer. The program planner can produce a static or a fluid performance. It is the latter which is preferred.

Criterion VI. *A televised mathematics program must use visualizations that are honest and illustrations that are clear.*

Television is primarily a visual medium; it must appeal to the eyes of the audience rather than just their ears. Even a talk, reading, or discussion should be presented in an interesting manner visually—however, it is possible to use too many visual devices and effects. The subject matter can dictate which ideas should be illustrated and which need not be.

An honest visualization is one that is necessary to clarify a point, illustrate a skill, or initiate thinking. A dishonest visualization is one that is used because it is pretty or clever, or complex, not because it is needed.

Illustrations must be clear. This implies that the physical nature of the illustration demands simplicity. Any extraneous information should be deleted. This further implied that the illustrations must clarify the

issue, not further confuse it, and that they are easily understood by the viewer.

Criterion VII. *A televised mathematics program must be performed by persons who offer credibility while making a good television appearance.*

It is in this area that televised mathematics programs have been most at fault. Too often it has been assumed that a good classroom teacher will make a good television performer. Unfortunately, such is not the case in most instances. Television performance requires certain skills and mannerisms that are in opposition to the skills and mannerisms of the classroom. For example, on television the performer must look at the camera, not all around the room as teachers are accustomed to doing.

Of course there have been exceptions. However, the probability of such an exception occurring is very low. If teachers are to be utilized as television performers they must be given time to learn the "tricks of the trade" before going on the air.

As guides to selecting the performing talent the following descriptions are suggested. The educational television teacher or performer should:

1. have a pleasant speaking voice;
2. have a pleasing physical appearance;
3. have a natural poise and dignity;
4. know his subject well;
5. be enthusiastic about mathematics;
6. be enthusiastic about television;
7. dress simply;
8. be comfortable in front of large audiences;
9. use impeccable but simple English.

If such a person is a classroom teacher, he may prove to be the exception.

Conclusion

Televising mathematics programs is a time consuming process. At least six-weeks of preparation and planning are required to produce a single half-hour program. If a series is to be produced, the time for each succeeding program will be less.

Under no circumstances should teachers be asked to produce a series of programs and carry a full teaching load at the same time. If one individual is to teach daily on television, this should be his only teaching assignments.

If mathematics *via* television is to be effective, each program should be produced from a complete script to which the performers will strictly adhere. These scripts must be completed well in advance of air time.

Obviously, this in itself is an expensive process. However, one must think in terms of thousands who will be affected, not merely hundreds. Then the expense will be more justifiable.

This then has been a mere sketch of the high points of producing a televised mathematics program. These high points, amplified by the subtleties, will make for more effective mathematics *via* television, but they will not guarantee it.

Teaching Algebra *Via* Television

DAVID W. WELLS

DURING the school year 1957-1958, the University of Nebraska conducted an experiment to determine the relative effectiveness of teaching first-year algebra by combining television and correspondence study and teaching first-year algebra by conventional classroom methods. One hundred students who were registered for first-year algebra in the small high schools within a forty-mile radius of the University television station, KUON-TV, served as the experimental group. Four hundred thirty-five students who were registered for first-year algebra in several Nebraska high schools served as the control group. To have as much assurance as possible that any difference in performance between the two groups might be attributable to the method of teaching, the students were given a test of mental ability and aptitude at the outset of the experiment. They were also given a test covering subject matter of the course to determine how much knowledge of algebra each possessed. The results of these tests were to be used as the basis for comparing the achievement of the two groups at the end of the school year.

A member of the faculty of each individual experimental school was selected to serve as television-correspondence study supervisor. The supervisors in about one half of the schools were teachers of mathematics. It was the responsibility of these people to develop and maintain an atmosphere conducive to learning in the television classroom, administer subject matter test and quizzes, and to make certain that assignments, tests, and other projects were mailed to the university according to instructions given to the students by the television teacher. In general, the local supervisor provided for liaison between the university and the school, but did not participate in actual subject matter instruction.

The students in the experimental group attended algebra class five days each week. On Monday, Wednesday, and Friday, the first half hour of the period was devoted to listening to the television instructor and taking whatever notes necessary. Each student had in his possession an algebra text and a correspondence study syllabus. In this syllabus each television presentation was outlined and the assignment covering the day's presentation was given. Since there were only three half-hour television presentations each week, most students had ample time to complete each assignment during the algebra period and before the next telecast. The schedule of three telecasts each week was adopted for two reasons. *First*, this experiment involved both correspondence study and television. Therefore, the burden of instruction could be divided between the two methods. The correspondence syllabus defined the follow-up activities for each television

David W. Wells, Director of Mathematics Education, Oakland County Schools, Pontiac, Michigan.

presentation. The follow-up always made provisions for drill. Two sets of problems whose solution required the skills and concepts considered that day were included. One set contained fewer but more difficult problems. The other set was described as a minimum assignment. The student selected the set he wanted to attempt.

Second, it seemed desirable to provide the student with as much time as possible to work on the assignment under the guidance of the local supervisor. In this way, if a question arose, the supervisor could assist the student in answering his own question or help him to formulate the question so that it could be forwarded to the university. More often than not, when the student was required to state exactly what his difficulty was, he answered his own question. However, when he was unable to answer his question, it was mailed to the television instructor. Since all the schools were within forty miles of the university, the television instructor received the question the following day. If, in the opinion of the teacher, the class would benefit from hearing this question answered, it was discussed during the next telecast. If it was not answered during a telecast, it was answered immediately by personal letter. At most, there was a two-day delay in answering students' questions.

However, this is not as great a disadvantage as it may seem. First of all, the students realized that this delay existed. They also realized the importance of keeping up their daily assignments. As a result they concentrated to a higher degree on what the television instructor was saying and doing than they would have in a conventional classroom. It was not unusual for a visitor to enter the television classroom during the tele-class and be practically unnoticed by the students. This would indeed be unusual in a conventional classroom. There is no doubt that a delay in answering the questions of interest to the entire class is a disadvantage. But it is certainly an advantage if the student, as a result of the method, can learn, to a greater degree, to work independently of the teacher.

What the student saw on the television screen was the result of the planning of the television teacher and the producer-director. In the planning period prior to each television presentation, the teacher would go over the concepts which were to be explained and outline how this might be done in the traditional classroom. The producer-director would then determine how this could best be done by television. Together they would lay out in great detail the location and movements of each camera during the tele-class. During the tele-class the producer-director was in absolute control. He directed the camera operators through an inter-studio communication system to insure that each shot was according to plan. It was also his responsibility to make certain that the student saw on his television screen exactly what he was supposed to see at a given time. After the content of the thirty minute tele-class had been determined, the planning, preparation of visual materials, and rehearsing required three to five hours.

At the outset, the television instructor thought that teaching by television would be a cold impersonal sort of experience. But he soon learned that this was not necessarily true. He was very much surprised at how much he could learn about each student by grading his papers, exchanging brief notes with him, and answering his questions. He soon began to feel that instead of teaching to the television camera, he was teaching a very small group, and he talked as if he were talking directly to this small group. Instead of his teaching being camera-directed, it was now student-directed. He felt as if he knew the students.

An examination of the class rolls indicated that almost every class had students named John, Robert, Bill, Betty, Mary, or Joan. Therefore, if the television instructor asked for a response to a question from John, or Betty, he received a response in almost every classroom. In this way a relatively few questions would give several students the feeling of being recognized and of being active class members.

Many other techniques were attempted to develop a closer pupil-teacher relationship. For example, students were invited to come to the studio to discuss the test over a unit of work in much the same way they would in a conventional classroom. Also, the names of the students who scored well or showed significant improvement on any quiz or test were shown on the screen and given recognition. The personal contact between the television teacher and student is certainly not as great as between the classroom teacher and student, but at the same time a very close relationship between television teacher and student can be developed.

A statistical analysis of the test scores at the end of the year showed that the mean score of the experimental group was higher than the mean score of the control group, but the difference was not statistically significant. These results were not surprising, since research report after research report reveal "no significant difference" between teaching *via* television and teaching by conventional classroom methods. To the writer, a more important outcome was the realization that teaching by television could be far more personal than imagined at the outset. With the aid of the television camera, the instructor can look directly at each student and at the same time seem to be only a few feet away. It was also encouraging to hear from local supervisors that the students taking algebra *via* telesion became more efficient in answering their own questions and came to be less dependent on the teacher.

It is unlikely that anyone will argue that teaching by television, even with a master teacher, will replace the excellent teacher in the classroom. But if a compromise is necessary, the potentialities of television should be thoroughly investigated. It offers an unusual opportunity for enrichment of instruction through visual presentation. It requires that the teacher carefully plan the presentation and be very discriminating in the selection of visual materials if the student is to learn with a concentration and vividness that will make longer retention possible. The challenge is to find the most effective way in which our educational system can use this new medium.

Explaining a Mathematics Program to Parents *Via* Television

LOUIS SCHOLL

WHEN school people think of educational television, they invariably think in terms of using television to teach subjects to students, whether those students of any age bracket are viewing the program in school or at home.

However, educational systems of a few cities—among them Buffalo, Pittsburgh, and St. Louis—have used television in a different way—to interpret the school program to the citizens of the community. Perhaps many educators are overlooking the most widely used function of television—that of advertising. In these days when education desperately needs greater financial support, a commercial approach may pay rich dividends in greater citizen understanding of the highly skilled and professional tasks which the schools are performing, with consequent increased financial support. It is suggested that the cause of education may be considerably advanced by making use of television in this way. In particular, that both best loved and most hated of all school subjects—mathematics—is ideally suited for use in this capacity. In planning such a program, there are six fundamental principles to be observed.

First, the primary purpose of the program must be kept in mind—that this program is to interpret the school program to the average citizen. In order to achieve this aim effectively, the program must use the facilities and methods currently in use in the school system. Whether aired over a commercial station or an educational channel, the program should not attempt to compete with any type of commercial program. Schools have many fine things capable of being televised which would be of great interest to the average viewer. Of course they have those greatest of all scene stealers—children. To put on a school television show without having pupils participate is to ignore a school's greatest attraction and strongest point.

The *second* guiding principle is that the program should be natural. This means that while the show is carefully planned from minute to minute, it should be completely unrehearsed. School people and school children are not professional actors and cannot possibly compete with a commercial show on a professional basis; but, on the other hand, they have much to offer with which the professional actors dare not compete. Rehearsing a school television show is the surest way to rob it of its freshness and make it deadly dull.

The *third* principle is that to have local impact, the show should be local in nature. Children and teachers from a local school should be used and

Louis Scholl is Director of Mathematics in the Buffalo Public Schools, Buffalo, New York.

frequent references should be made to names and places and conditions in the local area. Such a program will have much more interest to a local viewer than any network program can possibly have.

The *fourth* principle is that the program should make full use of the peculiar advantages of the television medium. These are the visual aspects of television, and the immediacy of live action. A test is to ask if a certain sequence in the program could be covered just as adequately by radio; if the answer is yes, that sequence should be revised. Live action of local people on television will carry a freshness and spontaneity that cannot be surpassed for interest and impact to the local community. This assumes that the program is natural and unrehearsed, although meticulously planned.

A *fifth* principle is that the teachers and pupils should be selected from the point of view of how well they represent the current school program, and not how good looking or photogenic they are. This means that the teachers who are the best teachers in the classroom will also be best on television. Children should be selected so as to get a representative cross section.

The *sixth* principle, and perhaps the most significant but, at the same time, the most difficult to follow, is that ideas should be presented rather than things; that professional techniques and problems should be stressed rather than picturing buildings or instructional materials. This is the "commercial" which the program must transmit, and as such it must be presented in an attractive and interesting way. It is important that the general public understand the ramifications of educational problems, and be given at least some inkling of the skill and knowledge demanded of a present-day teacher.

A type of public relations program which can be designed to embody the foregoing six principles is a capsule demonstration lesson in mathematics. Since it is often impossible for television cameras to go to a school, the school can be brought to the cameras by setting up a small classroom scene in the studio with from eight to twelve pupils and a teacher. Younger children such as first or second grade pupils are usually more interesting and less self-conscious, but any grade level may be used. A lesson should be planned which makes use of skilled teaching techniques. As an example, a first-grade class could be experimenting with the concept of five. Plastic doll furniture could be used, such as five ironing boards and five irons, five tiny doll carriages and five dolls, and other pairs of fives. The children would match them up, or add them, or experiment with greater than and less than, and various other activities, all under the guidance of a skilled teacher. In order to interpret what is going on, another teacher with an open microphone (not heard by the pupil) would intersperse comments and explanations as to the psychological techniques employed by the teacher and the learning abilities of the

pupils. Such a program must be carefully designed and planned, but depends for its interest on spontaneity. Rehearsal would be fatal.

A mathematics television program following the foregoing six principles will be interesting and valuable as a public relations tool. In addition it will be viewed by many teachers and thus serve as an inservice training program. PTA groups may meet to view and discuss the program. Programs of this nature have been televised in many communities. Educators should become more public relations conscious and make use of this valuable new tool—television.

Chapter VI

Mathematics and Evaluation

A New Approach to Evaluation of Competence

SHELDON S. MYERS

Older Viewpoints

THE point of view regarding the evaluation of competence or ability has been shifting since the issuance of the first individual intelligence test in point-scale form by Binet in 1905. At first, it was thought that the general intelligence test provided a measure of a single entity called "potential and native ability" as opposed to "acquired or learned ability." The concept of a *single* measure of ability was gradually modified with the application of factor analysis techniques, and the theory of a *spectrum* of primary mental abilities emerged. The *Chicago Tests of Primary Mental Abilities* by the Thurstones are a product of this approach. Because of the unwieldiness of a comprehensive battery measuring so many abilities, tests were designed to measure only the linguistic and quantitative clusters of the larger set of abilities. Examples of tests which yield linguistic or verbal and quantitative or mathematical scores are the *Ohio State Psychological Examination*, the *American Council on Education Psychological Examination*, the *School and College Ability Tests* (Cooperative Tests), and the *Scholastic Aptitude Tests* (College Board).

With the development of the latter tests, the point of view shifted from that of measuring potential or native capacity to that of measuring aptitude for future academic work. With this shift the older distinction between native and acquired ability no longer was relevant. In fact, not only was the distinction irrelevant, it also became evident that the best tests could only produce scores which reflect the combined influences of heredity and environment. Consequently, in recent terminology such tests as the *Scholastic Aptitude Test* and the *School and College Ability Tests* became known as "tests of developed ability." The scores of students on such tests will necessarily reflect the influences of stimulating teachers, a good curriculum, understanding parents, as well as native ability.

The shifts in viewpoint just described bring us up to the present. We will now describe the new approaches to the measurement of competence

Sheldon S. Myers is Head of the Mathematics Section, Test Development Division, Educational Testing Service, Princeton, New Jersey.

which appear to lie ahead and will confine our remarks to mathematical competence or ability.

A New Approach

Up to now the portions of academic ability tests concerned with quantitative ability have been narrowly confined either to arithmetic computation and reasoning or have been only extended beyond this to include some traditional aspects of simple algebra and metric geometry. The purpose behind this was to restrict the tests to material which all the students taking the test could reasonably be expected to have had and thus eliminate subject matter achievement differences among them. This technique of scholastic aptitude testing rested on the assumption that the measure of ability to work with familiar subject matter is a good predictor of how well the subject will learn to work with unfamiliar subject matter in the same general area. Contrasting with this, another approach would be to measure ability to learn unfamiliar subject matter. Some tests of this nature have been attempted in the area of learning a strange language. Two reasons which have tended to restrict aptitude testing in mathematics to the former of these two approaches are (1) a narrow and limited conception of what constitutes mathematics and (2) the prerequisites necessary to work with novel material in mathematics make such questions impractical. It is our purpose to show by discussion and illustration that neither of these reasons is valid.

The conception of mathematics today has been broadened to a point so that we can characterize mathematics by the statement "Mathematics is the study and classification of all possible patterns, pattern being any kind of regularity." Therefore, in the light of this statement, patterns of logic would be an intimate part of mathematics. Consider for example, the following question:

If all members of organization K with characteristic L are placed on committee M, which of the following statements must be true?

I. Every member of committee M who has characteristic L is a member of organization K.

II. Every person with characteristic L who is not on committee M is not a member of organization K.

III. Every member of committee M who does not have characteristic L is not a member of organization K.

(A) I only (B) II only (C) III only
(D) I and III only (E) I, II, and III *Key is B.*

Formerly this kind of question would have been excluded from scholastic aptitude tests with the comment, "This question is a logic question, not a mathematics question, and, therefore, does not belong in a test of mathematical competence." The broader modern conception of mathematics would indicate that this problem is mathematics and a legitimate question in a test of mathematical aptitude. It is also quite interesting to note that pretest analysis of this question has shown that it

correlates quite well with the criterion of a typical aptitude test in mathematics. Future aptitude tests in mathematics will probably include more questions of this type.

Another question which seems to measure the ability to observe numerical patterns is the following:

Which of the following numbers could not possibly be the square of an integer?

(A) 123454321 (B) 345676543 (C) 3086358025
(D) 4444355556 (E) 1111088889 *Key is B.*

In solving this problem, one needs only to observe that the squares of numbers must end with 0, 1, 4, 5, 6, and 9, and not 3, as in the case of choice B above. The other choices happen to be perfect squares.

It seems likely that the content of scholastic aptitude tests in mathematics will broaden not only because of the newer conception of mathematics but also because the testing of novel thinking in mathematics is gradually being found to be practical. This does not necessarily mean including mathematical subject matter well beyond what the students have had. Rather it involves insightful ways of looking at familiar material, such as the question above. Sometimes a question will combine reasoning with use of a relatively new symbol, such as the following:

Which one of the following must be *excluded* in order that the remaining four are consistent?

I. $a > b$
II. $a > d$
III. $b > c$
IV. $c > a$
V. $d > c$

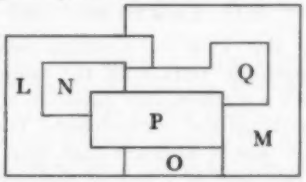
(A) I (B) II (C) III (D) IV (E) V *Key is D.*

In order to be fair, such new symbols should be defined either at the beginning of the test or in the question itself.

The expanding conception of the dimensions of a scholastic aptitude test in mathematics may even involve the establishment of new patterns of thinking, such as the following question:

Suppose we were to find a map with six countries, L, M, N, O, P, and Q as in the figure, and we were to paint the map with 4 different colors so that no two countries with a common border were painted with the same color. Which of the countries listed below could possibly have the same color?

(A) L and O
(B) L and M
(C) N and O
(D) N and Q
(E) O and Q



Key is E.

In this question, choices A, B, and D can be eliminated by observing that these pairs of countries have common borders. Choice C can be eliminated by assuming that N and O have the same color and showing that the other countries cannot be properly colored with the remaining three colors. Choice E cannot be eliminated in this way.

The following question is modern in spirit and illustrates the tendency to blend algebraic and geometric thinking:

The sides of a triangle are 9, 12, and x. What are the values of x for which the triangle will be acute?

(A) $x < 21$ (B) $x > 3$ (C) $3 < x < 21$
(D) $x < 15$ (E) $3\sqrt{7} < x < 15$

Key is E.

In modern terminology, this question requires finding a "solution set" in the domain of the variable. In terms of formal subject matter it does not involve anything more than the Pythagorean theorem, but requires superior mathematical thinking to solve.

From the illustrative questions thus far presented, it can be seen that newer approaches to ability testing in mathematics will be in the direction of newer and more varied content requiring insightful and creative thinking. The familiar aptitude problems of the past calling upon the straightforward application of previously learned procedures to familiar situations will not disappear, but will make up a lower portion of the content of these tests. Two questions of the latter kind are illustrated by the following:

A man drives 8 miles north and 15 miles west. How many miles is he from his starting point?

(A) 16 (B) 17 (C) 20 (D) 23 (E) 60 *Key is B.*

If $y = 3x + 4$, then $4y - 9 = (?)$
(A) $12x - 20$ (B) $12x - 5$ (C) $12x + 7$
(D) $12x + 16$ (E) $12x + 25$ *Key is C.*

Curricular Implications

Modern mathematics is not modern in content only; it is modern in its approach as well. Modern mathematics in the high school and college today requires that teacher and student approach the study of mathematics creatively. It is for this reason that newer approaches to the measurement of mathematical competence will stress original and creative thinking, because it is this kind of thinking which will play an ever greater role in later courses of the student.

In order to stimulate original thinking on the part of students, teachers need not necessarily depart very far from the usual arithmetic, algebra, and geometry. For example, in arithmetic alone there are limitless possibilities for students to investigate the properties of numbers. Polygonal numbers, perfect numbers, prime numbers, odd and even numbers, and

numbers of different bases are a few arithmetic topics in which students can do some original thinking and exploration. The following question illustrates the possibilities of original thinking with odd and even numbers:

The average of 13 consecutive whole numbers is odd. The product of the first and last of these numbers must necessarily be

(A) odd (B) even (C) multiple of 7 (D) multiple of 13

(E) multiple of the average of the 13 numbers *Key is A.*

The solution depends on recognizing that the middle or seventh number is equal to the average and, therefore, must be odd. This would make the first and last numbers odd, and, therefore, the product of these would be odd.

The last point to be made is that test makers cannot abdicate their curricular responsibilities either by excessive test security or by a conservatism which keeps the content of their tests aloof from modern changes in subject matter and points of view. For better or for worse, tests always have and always will influence school practices. It behooves the test maker to construct tests with the most beneficial influence as possible. It would seem that the newer approaches to mathematics aptitude testing described here would exert such a beneficial influence. With these newer approaches, short term coaching for aptitude tests will be even less profitable than it has proved to be in the past. The best preparation for the new tests will be the pursuit of a good mathematics curriculum over the years. Since the new tests will be tests of developed ability to an even greater extent, better performance on such tests will be the result of stimulating teaching along questioning and discovery lines.

What Can the Classroom Teacher Do About Evaluation?

DONOVAN A. JOHNSON

ONE of the continuous activities which we face as classroom teachers is the evaluation of the achievement of our students. It is a time-consuming activity which may frequently be tedious as we work out our test questions, score papers, record marks, and make out grades. It is frequently a discouraging task when we fiind out how little our students have apparently learned from our carefully planned instruction. But it is an important, reoccurring task which is becoming increasingly important when we are committed to having each of our pupils achieve to the maximum of his potential. And with the current need for developing our intellectual resources to a maximum it becomes an essential activity for every mathematics teacher.

Donovan A. Johnson, University of Minnesota High School, Minneapolis, Minnesota.

The evaluation of achievement in mathematics is important because it plays many roles in the classroom. One of the most important of these is the improvement of instruction. It is through evaluation activities that you locate your present status and measure the progress you make in the direction you wish to go. It is evaluation which will determine the effectiveness of the techniques, materials, or content you are teaching. Thus, it is the basis for selecting topics and methods of teaching these topics.

Another major function of evaluation is its potential for improving the progress of individual students. We need to use tests to determine the readiness for instruction, to diagnose weaknesses and strengths, to locate difficulties and faulty mental processes. Remedial instruction is then planned to fit the needs of individual students. The measures of mathematical aptitude and achievement can then be used to guide the student into courses and vocations suited to his aptitude.

With the current ferment involving the mathematics curriculum and the criticism of education, evaluation can furnish data to answer questions being asked. Test results furnish data on which to render judgment as to the quality of a particular mathematics program. The need for accurate, extensive data for research projects now and in the future should stimulate us to collect as much data as possible about our students. The increasing standards for admission to colleges and employment further emphasize the need for accurate records of the potential and the actual achievement of our students.

Of course evaluation activities in themselves are of value to the student participating in them. Competition with one's own record, the class record, or national norms can be a stimulating experience, at least for the successful student. Completing a test is an intense learning experience in itself. Discussing and correcting errors on a test help to locate errors, misunderstandings, and wrong procedures as well as to reinforce correct learnings.

A basic consideration for us to have in mind in evaluating our students is the goals of our instruction. We must be clear as to what our goals are so that we can measure the progress we have made toward attaining these goals. This means that we need to measure in terms of *all* our goals. In general it is easy to measure the progress or growth of our students in building computational skills or in learning facts and rules. As we do this however, we need to be reminded of the importance of measuring understanding as well as accuracy and efficiency. But evaluation of achievement in mathematics must be more than measuring skills and knowledge. If we accept goals such as attitudes and appreciations, we need to measure our students' status relative to these goals. If we are teaching how to study mathematics or how to read mathematics, we should test our students' progress in learning these skills. If we are attempting to teach how to apply mathematical learning to new situations,

we need to devise tests of this ability. If we are building skill in thinking logically and critically in non-mathematical situations as well as mathematical ones, we will need to build test situations or items in which the student can exhibit his ability to do these things. Thus, it is apparent that we shall need to use a variety of evaluation instruments in our classrooms. In the way of tests and examinations it means not only the typical test with computational problems, but also reading tests, vocabulary tests, open-book tests, take-home tests, performance tests, attitude tests, and tests of logical analysis or problem solving. We shall need to use a variety of test items similar to the following:

The Meaning of a Process

1. In the problem 54 x 23, what is the mathematical explanation of the reason we write the 8 under the 6?
   (A) We write the product under the multiplier.
   (B) We write the product in the ten's place because the multiplier is a ten.
   (C) We move over one place when multiplying by the second figure.
   (D) We are using a short cut that works.

	54
	23
	162
	108
	1242

2. The multiplication of 24 by 3½ is the same as 24 multiplied by 3.5. Why do we not indent the partial product 72 in the second example as is done in the first example?

24	24
3.5	3½
120	12
72	72
84.0	84

   (A) The multiplier 3 has a different place value in each example.
   (B) The multiplier .5 and ½ are not equivalent.
   (C) The fraction ½ does not have place value.
   (D) The multiplier 3 and ½ have the same place value.

The Meaning of Numbers

1. In the number 842, the 8 has a value that is
   (A) twice the value of the 4
   (B) four times the value of the 2
   (C) twenty times the value of the 4
   (D) forty times the value of the 2
   (E) two hundred times the value of the 4
2. A fraction with a large denominator may be larger than a fraction with a small denominator.

Visualizing a Process

1. The line given for each example below is 2½ inches long. Show how you can get the answers to these examples by dividing the lines into fractional parts. Label your diagram, so that the process is explained.

A. $1\frac{1}{4} + 1\frac{1}{4} = 2\frac{1}{2}$

B. $2\frac{1}{2} - \frac{3}{4} = 1\frac{3}{4}$

C. $\frac{1}{2} \times 5 = 2\frac{1}{2}$

D. $2\frac{1}{2} \div \frac{1}{4} = 10$

2. The line given for each example below is 10 centimeters long. Divide the line into fractional parts and label your diagram to show the meaning of the answers to these examples

A. $.4 + .5 = .9$

B. $.75 - .20 = .55$

C. $.8 \div .2 = 4$

D. $.2 \times 3 = .6$

3. Label the four parts of this rectangle to show the partial products of $(x + 2)(x + 3)$

Performance Test

1. Materials: Irregularly shaped paper; carpenter's square; compass; ruler; shears.

Station No. 1—At this station you are given irregularly shaped pieces of paper and several devices to aid you in performing the required tasks.

_____1. Construct a triangle containing two 45 degree angles by folding a piece of paper.

_____2. Construct a 30-60 degree right triangle by folding.

_____3. Fold and cut a scalene triangle. Locate the three altitudes of the triangle by folding.

2. Materials: Container of damp sand–cement mixture; home-made height guage; graph paper—5 sqs. to an inch.

Station No. 2—The sand-cement mixture has been poured in the shape of a cone on the graph paper. The graph paper has been marked off in inches.

_____1. Assuming the base of the pile to be circular, what is the area of the base?

(A) $A = \frac{169''}{16}$ (B) $36''$ (C) $\frac{169''}{4}$ (D) $9''$

_____2. What is the height of the pile?

_____3. The formula for finding the volume of a cone is $V = \frac{1}{3} \pi r^2 h$. What is the volume of this cone?

Finding Information—Select the answer for each of the following items, that is the best source of the information needed.

1. The best place to find page references about a specific topic in a textbook is to look for the topic in the
   A. Preface B. Table of Contents C. Chapter Summaries D. Index
2. You are unable to recall the name of the author of the book *Makers of Mathematics*. Where would you look to find whether this book is in your school library?
   A. in the *Readers Guide to Periodical Literature*.
   B. in the card catalog under *Makers*
   C. in the card catalog under *Mathematics*
   D. among the books in the "M" shelves of the library.
3. In which could you find the most data concerning the athletic contests in the United States during the last decade?
   A. A World Almanac
   B. A geography textbook
   C. An encyclopedia
   D. A world atlas

Applications and Interpretations

1. In which one of the following schools does the largest proportion of the pupils have bicycles?
   A. 80 bicycles for 240 pupils.
   B. 24 bicycles for 96 pupils.
   C. 120 bicycles for 540 pupils.
   D. 6 bicycles for 15 pupils.
   E. 18 bicycles for 63 pupils.
2. Which one of these is the best buy?
   A. 12 for $1.00
   B. 10 cents each
   C. 5 for .38¢
   D. 7 for .55¢
3. Which of the figures shown below is an exception to the statement: If the diagonals of a quadrilateral are equal, it is a parallelogram.

Mathematics Reading Test

A number that has been of great interest to mathematicians is a prime number. A whole number greater than one is called a prime number if it can be divided evenly only by itself and one. The smallest prime numbers are 2, 3, 5, 7, 11, 13, *etc.* The number 1 might be considered prime, but this is not the custom. To do so would force us to state exceptions to many statements about prime numbers. For this reason 2 is considered the smallest prime number. Information about prime numbers is important because they are the building blocks of all numbers. Many statements in the study of numbers are based on whether or not a number is prime. More than 2,000 years ago, Euclid,

who is most famous for his book on geometry, proved that the number of primes is infinite.

Another interesting group of numbers has been named perfect numbers. These numbers are the whole numbers which are exactly equal to the sum of all their divisors except themselves. The smallest perfect number is 6 for the divisors of 6 are 1, 2, 3, and $6 = 1 + 2 + 3$. Some numbers, such as 10, have divisors that add to less than themselves. $5 + 2 + 1 = 8$. These integers are called "deficient" numbers. Some numbers, like 12, are called "excess" numbers because the sum of the divisors is more than themselves.

1. Which one of the following is a prime number?
   - A. 51
   - B. 55
   - C. 57
   - D. 59
2. The number of even primes is
   - A. infinite
   - B. unknown
   - C. equal to the number of odd primes
   - D. one
3. Which one of the following statements is true?
   - A. The decimal .6 is a perfect number since $.1 + .2 + .3 = .6$
   - B. The decimal .5 is a prime number.
   - C. The number 36 is an excess number.
   - D. The smallest prime number is 1.

Methods of Reasoning

Directions: In each answer space, write the letter of the method of reasoning that is there illustrated. Any letter may be used as often as it is needed.

(a) stating a generalization by examining particular cases (b) reasoning from a general statement to a particular case (c) arranging a proof in orderly fashion (d) analysis (e) method of analogy (f) indirect method (g) none of these

1. If a girl can sew, she will save money on clothes. Mary can sew. Therefore, Mary will save money on clothes.... _____
2. When a mechanic attempts to determine why a car will not start, he may begin by checking in order, the spark plugs, wiring, battery, and continuing in this way until he locates the trouble..... _____
3. I can prove that two arcs of a circle are equal, if I can prove that the chords are equal. Each cord is 5 inches from the center of the circle. Therefore, I can prove that the two arcs are equal..... _____
4. A robin has feathers; a sparrow has feathers; an oriole has feathers, and many other birds have feathers. Thus one might conclude that all birds may have feathers..... _____

Relationships in Problems—From the problem, table, and diagram, decide which of the following equations are true. Mark the true statements below with a plus, the false with a zero and the unknown with a question mark.

(A) "Two friends, Bill and Joe, live in towns M miles apart. Deciding to meet at the earliest possible time, they leave their own homes at the same time

and drive toward each other. Bill travels *b* miles per hour and Joe travels *y* miles per hour. How long will it take them to meet?

	Distance	rate	time
Bill	a	b	c
Joe	x	y	z

1. $ab = c$
2. $a + b = c$
3. $x = yz$
4. $a = x$
5. $b = y$
6. $c = z$
7. $a + x = bc + yz$
8. $a + x = M$
9. $a\,x = M$

(B) "When a golf ball is thrown to a height of 24 feet it rebounds one fourth the height from which it fell. How far has the ball traveled when it strikes the sixth time?"

____1. This will be a geometric progression.
____2. The first term is 24.
____3. It is impossible for a golf ball to rebound this much.
____4. $n = 5$
____5. $d = \frac{1}{4}$
____6. The distance the ball travels is found by finding the last term of a progression.
____7. The ball travels about 40 feet.

Of course the evaluation of all of our objectives cannot be done by tests alone. Work habits, curiosity, creativeness, communication skills will need to be evaluated with so-called non-testing appraisal instruments. These include such devices as questionnaires, checklists, progress charts, rating scales, interviews, and diaries. In addition, there are completed student products such as assignments, projects, and reports to be examined and rated. Here one must consider communication skill, craftmanship, organization, and creativeness in judging the quality of the product. There are the daily observations of classroom performance to record and evaluate. However, we need to be careful to distinguish between learning activities and evaluation activities. Most assignments should be for the purpose of promoting learning rather than for the purpose of establishing a mark. An assignment is worth while because of the learning it promotes, not as a means of getting a grade.

Besides teacher-made appraisal instruments, we need to capitalize on the wealth of available published evaluation materials. These tests are constructed by experts, are based on extensive experimentation, and have established norms. These published tests include tests such as prognostic tests, diagnostic tests, unit tests, and long-range achievement tests. Some of them emphasize the manipulative aspects of mathematics but some of them emphasize interpretive items or application situations. Some of them can be used to measure year-to-year progress in mathematics, while others measure achievement in specific topics or subjects. Published tests usually furnish norms such as grade equivalents or percentile ranks or standard scores. These norms can be very useful if interpreted intelli-

gently in terms of the sample on which the norms are based. To be "up" to the norm also means that you are "down" to the norm. The norms may be unsatisfactory as a standard or measure of a class because the class may be very different in aptitude then the norm sample.

Thus, measurement in the mathematics classroom is a highly technical task for which we need adequate materials and original ideas. It becomes a highly satisfying experience for the learner and the teacher when it is done in an accurate and comprehensive manner.

Mathematics Evaluation in a Large City

MARIAN C. CLIFFE

EVALUATION is an important phase of any educational program. In the Los Angeles city schools, evaluation in the area of mathematics is considered to be an essential part of the total curriculum. Accordingly, suggestions of evaluative techniques and procedures are written into the instructional guides and course outlines prepared for the various mathematics courses offered in the junior and senior high schools.

Evaluation in a large school system presents problems, some of which may be inferred by a brief consideration of a few of the characteristics of the Los Angeles city school system. Geographically, the school district is large, covering an area which extends 25 miles in an east-west direction and 38 miles in a north-south direction. Within this area are located 43 senior high schools and 52 junior high schools. Populations differ in the various school localities which range from highly industrialized to exclusively residential, from urban to almost rural, and from predominantly stable to predominantly transient.

The characteristics and needs of the total school population make necessary a diversity of offerings in mathematics. These offerings comprise a multiple-track program which includes junior high-school exploratory, college preparatory, general, and industrial sequences. Each course within the sequences has unique purposes and aims in addition to the objectives had in common with other courses. These purposes and objectives form the basis of an evaluation of pupil achievement in mathematics.

In Los Angeles city schools, it is generally agreed that evaluation in the area of mathematics should answer questions such as the following:

Marian C. Cliffe is Supervisor of Mathematics in the Los Angeles Public Schools, Los Angeles, California.

Is the student "measuring up"?

Does he show growth in understandings, computational skills, problem-solving ability?

Is he accurate?

Does he show an increasing ability to recognize and define the problems which exist in given sets of data?

Does he show growth in his ability to read and report material having mathematical content?

Can he take notes intelligently on verbal presentations of mathematical materials?

Does he demonstrate a growing interest in mathematics at his highest level of comprehension?

Does he show an increasing tendency to apply his mathematical knowledge to situations requiring its use?

Does he show a growing appreciation of the role of mathematics in today's world?

Does he demonstrate increasing facility in the use of the vocabulary of mathematics?

Does he engage in independent research and study on a level commensurate with his ability in mathematics?

To find the answers to questions such as these, several different types of evaluative techniques must be employed. Some of these are objective while others, because of their nature, depend upon the subjective judgment of the evaluator. In this latter category are the evaluation of growth, appreciations, attitudes, enthusiasm for mathematics, confidence, and the like. On the other hand, objective appraisals may be made of skills, accuracy, understandings, problem-solving ability, original thinking, comprehension of written material having mathematical content, and note-taking ability.

In Los Angeles city schools, the evaluation of the mathematics program is undertaken in a number of ways. First should be mentioned the mathematics sections of tests used in the general evaluation of the educational program. Every pupil in junior and senior high school is tested at 2 year intervals during his secondary-school career. For this purpose, the *California Achievement Test* is used in grades 7 through 9 and the *Iowa Test of Educational Development* is used in grades 10 through 12. Thus, each pupil's achievement is evaluated three times—twice in junior high school and once in senior high school or once in junior high school and twice in senior high school, depending upon the year of his admission to the junior high school. These tests are administered in the local schools under the supervision of the school counselor, the city supervisor of counseling and guidance, and the evaluation section of the administrative staff. This section is responsible for reporting and interpreting the test results to individual schools. The counselor's office in each school records the test results on pupils' cumulative record cards and also makes them available to teachers in the various subject fields.

The *California Achievement Test*, used in grades 7 to 9, includes sections on mathematical skills and reasoning, while the Iowa battery includes a test on "quantitative thinking." Scores on the former test are measured in terms of grade place, while results of the latter are reported in percentiles. Both of these tests provide objective data of importance to the classroom teacher. While such tests do not replace subject matter achievement examinations, they do yield valuable information about the pupil's ability and his progress in mathematics.

A second means used for evaluating pupil progress in mathematics in Los Angeles city schools is the series of tests obtainable from the curriculum branch of the central administrative offices. The use of these tests is entirely optional with the individual school and teacher. The curriculum tests are developed by teacher committees working with mathematics supervisors. Frequently, a secondary-school administrator with a background in the field of mathematics is invited to work with the committees that construct evaluative materials.

Such tests have distinct advantages. They are comprehensive, they cover the course content specifically, and they are sequential in that they are developed as a series rather than as isolated sets of questions. They result from concensus, they are modifiable, and they are available when needed.

In addition to curriculum tests in mathematics provided by the central office, there are in use many tests prepared by the mathematics departments of individual schools. These tests are usually developed cooperatively by the mathematics department faculty or a committee of teachers under the leadership of the mathematics department chairman.

School norms are established on the basis of results obtained from testing in the schools. These tests have the advantage of being related specifically to the subject matter which has been taught in a particular situation. They have the disadvantage of being narrow at times. The way in which they are developed makes it possible for them to contribute to a healthy growing situation or to a static or ingrown condition within a mathematics department.

A fourth type of evaluative instrument used for some courses in mathematics is the test series prepared by the author of the textbook in use in the class. Such tests have the advantages of being geared directly to the content of the text and of giving the teacher a sense of security. They have the disadvantage of presenting only one point of view and an emphasis which may or may not be the emphasis desired for the course.

Finally, there are the tests prepared by the individual teachers for use in a particular situation. Such tests have the advantage of being tailored to a special use. When they are carefully thought out beforehand, they can be very valuable. They are specific, flexible, and quickly available. They tend to be diagnostic in that they immediately identify areas in which re-teaching or individual help is necessary.

It must be remembered that not all teachers can be expected to be expert in the science of test construction nor are they always able to devote the time necessary to the development of a well-balanced testing instrument which will accurately measure mastery of the important concepts developed in the course.

Mathematics tests prepared in any of the aforementioned ways may be of various or mixed types. The most commonly used in Los Angeles city are the free answer, multiple-choice, completion, and true-false tests. The majority of teachers appear to prefer the free answer type of test of problem solving ability or fundamental skills, but most of them employ the other types as well, particularly in testing a knowledge of mathematical concepts, vocabulary, and meanings. These various types of tests provide adequate means of evaluating pupil progress.

A second important phase of any evaluation of mathematics concerns itself with an appraisal of the instructional program. Questions which arise in this phase have to do with the curriculum and the teacher.

Is the mathematics program adequate to meet the needs of all types of pupils?

Is the program modern? Does it take cognizance of trends? Does it meet today's needs?

What about the contemporization of teachers? Have attempts been made to effect this by the provision of opportunities for in-service training and by salary incentives for refresher and extension courses?

Does the individual classroom teacher provide mathematical experiences which enable pupils to reach their maximum development?

Does the teacher provide enrichment opportunities commensurate with the abilities of individual members of his class?

Does the teacher have a background of information in mathematics from which he draws appropriate explanations, illustrations, and applications?

Do pupils feel confident in mathematics or are some discouraged, insecure, perhaps frightened? Are situations structured in each class so that every pupil can at some time experience success in mathematics?

Do pupils associate a high mark with "good boy" and a low mark with "bad boy" or does each pupil feel accepted and welcome in the mathematics class?

The appraisal of the instructional program in Los Angeles is the joint responsibility of the individual school principal and the administrative staff of the school system. However, some mathematics faculties have taken advantage of recently provided opportunities for self-appraisal within individual departments and have found the experience to be well worth while. A department's evaluation of its own instructional program was achieved by means of a schedule of mutual visitation with subsequent conferences and comparing of notes. No administrators participated. The teachers were free in their criticisms of each other and their suggestions for improvements. Most of those who participated said that they found the experience to be well worth the effort and felt that their own classroom techniques had improved as a result of the program.

No plan of evaluation can completely explore all of the intricacies of the learning and instructional processes in mathematics, but the methods just described have been found to provide the information which one large city school system needs as it carries on a continuous program of improving its mathematics offerings.

Evaluation in a Large State: New York Regents Examinations

FRANK S. HAWTHORNE

THE Regents examinations system, consisting of uniform, statewide examinations in academic, secondary-school subjects, has been a hallmark of New York education for over ninety years. Three times a year, in January, June, and August, identical examinations are given simultaneously to students all over the state, in schools large and small; public, private, parochial, and prison. The tremendous scope of the program is illustrated by the fact that more than two hundred thousand such examinations in mathematics alone were administered in grades ten, eleven, and twelve in 1957. This number does not include the approximately one hundred thousand examinations in preliminary (eighth grade) mathematics.

The Regents examinations in mathematics are prepared by a committee of one college professor and five experienced classroom teachers (none of the present members of the committee having taught fewer than twenty years). This committee meets with the state supervisor and his staff. Previous to the meeting, the members of the committee devote much time to composing and framing questions in the particular area each has been assigned. These rough draft questions are exchanged by certified mail some two weeks before the scheduled meeting and each member prepares comments on the questions suggested by the others. The actual committee meeting usually lasts four days and is devoted to a consideration of the accuracy, wording, difficulty, and suitability of the items as well as the over-all scope and balance of the tests. To insure that the questions are within the framework of the official state curriculum, each question is carefully checked against the pertinent paragraphs in the syllabus.

After this committee's work is completed, the tests are carefully reviewed by other teacher consultants, by the mathematics supervisor and his two associates, by testing specialists, and by Departmental editors.

Frank S. Hawthorne is Supervisor of Mathematics Education in the New York State Education Department, Albany, New York.

They are then duplicated in a form as nearly final as possible and submitted to a revision committee of school administrators for final approval. Keys to the tests are then prepared by the Departmental staff and the examinations are ready for the printer. Every step in the preparation is carried out under conditions of maximum security.

The actual printing is done on guarded presses in the basement of the state education building. The tests in each subject are sealed in envelopes clearly marked with the title of the examination and the date and time of administration. These are shipped to the principals of schools in locked steel boxes, the keys to which are mailed separately.

At the appointed time, the envelopes are opened in the presence of the students assembled to take the tests. At the end of three hours, the papers are collected and are rated locally by the classroom teachers. All papers are then retained by the school for one year. About 20 per cent of these papers are called for review by the State Education Department in Albany. These papers are re-rated by Department raters who are assisted during the summer by a staff of experienced classroom teachers recruited for the purpose. Papers of individual schools are sampled. If the sampling reveals a failure to maintain rating standards, all of the papers from that school may be reviewed. Each school receives from the Department a notice of variations between local and state rating of the papers of its individual pupils. Permission to grant Regents (state) diplomas by individual schools depends on reasonable agreement of local and state rating.

Teachers are encouraged to comment concerning examinations and are furnished with special forms for this purpose. A synopsis of such comments is prepared and provides "feedback" to the committee members preparing future examinations.

During the calendar year 1957, twenty-four separate examinations in mathematics were administered under this system.

The basis for the position of Regents examinations in New York state lies in the advantages they offer to the pupils, the schools, and the people of the state. These examinations are excellent achievement tests which, because of the great care with which they are constructed, are far superior in quality to tests that any single school can prepare with its comparatively limited resources.

Regents examinations provide the schools with a measuring instrument through the use of which each may reassure itself that its pupils are being given the educational opportunities they deserve. The examinations also provide a strong supervisory instrument by means of which high levels of academic achievement may be stimulated throughout the state.

Research studies have shown that Regents examinations are excellent devices for measuring probable success in future study. Therefore, they provide the colleges, the high-school guidance counselors, and the pupils

with valuable information from which prognoses concerning future academic success may be made.

Regents examinations establish a fair uniform and democratic state standard in secondary education. Credits earned in a small rural high school, or in the Sing Sing Prison School, are equated with those obtained from high schools in America's largest city.

Students who pass Regents examinations in all subjects of any of several possible specified distributions and who have a total of at least eighteen academic credits receive a state high-school diploma which is separate from and in addition to the regular local school diploma. Beginning in June 1959, two special forms of the state diploma will be given. One of these is for students who maintain an average of ninety per cent or higher on Regents examinations and the other, for those who have completed sequences in both mathematics and science with Regents examinations in all courses in these fields. Students who qualify for both these types will receive a combination diploma.

Each school is encouraged to recognize that Regents examinations are only a partial basis for evaluation of student success and must be supplemented by local testing programs if the needs of all the youth are to be served.

That it was not, at least in recent decades, the intention of the Board of Regents to have the Regents examinations constitute the sole basis for promotion and graduation is quite clear from the record. Despite this and the fact that Regents examinations offered only a partial measure of the outcomes and objectives of secondary education, pupils, teachers, and schools have been too often evaluated solely, or chiefly, on the basis of the results obtained on these examinations.

In an attempt to dispel the last shreds of doubt from the minds of school administrators concerning the proper use of these tests, the department issued in 1950 a statement which defines the role of Regents examinations in New York state schools.

> Regents examinations are recommended to the schools for general supervisory purposes and as partial measures of achievement for pupils of average and above-average ability who pursue courses of study within a curriculum framework upon which Regents examinations are based.
>
> Regents examinations are not intended to be used for measuring the accomplishment of all high-school pupils. The proportion of the pupil population in any one school to whom Regents examinations may be properly administered will vary with the needs and interests of the pupils enrolled in the school. In some schools, a much greater proportion of the pupil population will be properly concerned with preparation for college than in other schools. In some cities, special schools or divisions are set up for pupils who are scholastically gifted along one or more lines, such as in science, the fine arts, or in technical fields. The proportion of pupils who may properly take state examinations in such schools will, as a matter of course, be much greater than in comprehensive high schools in smaller communities. The success of an

individual teacher or school may not, therefore, be properly measured or compared solely in terms of Regents examination results.

Section 21 of the Regents Rules relating to apportionment provides in part that schools receiving state aid shall make general use of Regents examinations in the third and fourth years of the secondary-school course. THIS SHOULD NOT BE INTERPRETED TO MEAN, HOWEVER, THAT THE SCHOOLS MUST ADMINISTER REGENTS EXAMINATIONS TO ALL PUPILS. Such administration represents an abuse of the examination system and tends to destroy rather than increase the validity of the state examinations program. As recommended by the Education Department for many years, the local high schools are obligated to develop local examinations and other means of evaluating the learning of pupils who may not properly be served by Regents examinations.

One of the most common criticisms of a uniform testing system such as the New York State Regents examination program is the claim that it tends to stifle individual initiative and to prevent schools from making forward steps in curriculum development. The present situation in mathematics does not appear to support this argument. Indeed, the facts are quite contrary to this thesis. The present New York state syllabus in mathematics is widely recognized as unusually "modern" and is in substantial agreement with the more advanced thinking of the several commissions and committees of national scope now actively engaged in the study of secondary mathematics curricula. "But," as Kipling so frequently said, "that is another story."

Chapter VII

The Mathematics Teacher, Present and Future

The Education of Teachers of Mathematics

HOWARD F. FEHR

THE focal point of successful education in mathematics is the teacher. The greatest factor in the lack of student interest and in the poor quality of product of some of our schools is the lack of mathematical knowledge on the part of our teachers of mathematics. In many classrooms, one can see instances of either rote meaningless teaching or the presentation of incorrect concepts. These teachers, many of them with majors in mathematics from good colleges, have just never learned mathematics as a dynamic conceptual structure—to them it is mainly a set of manipulative tricks, which they are passing on to their pupils.

Now it is evident that no teacher can teach what he does not know. In the elementary and secondary school, where the fundamental learning for future use and study takes place, the teacher must know thoroughly and accurately everything which he must teach. Beyond this, a teacher must believe in what he teaches, as knowledge that is essential, interesting, and vital to the affairs of men today and tomorrow. He must know where and how mathematics is used, as well as the aesthetic satisfaction that comes from a complete understanding of the subject. But he must know more than his subject—he must know how to communicate it in a motivating, satisfying, interesting manner so that his students come into possession of treasured knowledge. In fact, the teacher of mathematics should teach as B. V. Gredenko recently said the USSR *demands* that its teachers do.

> A teacher who reduces his task to the point that he only communicates to the pupil the sum of knowledge specified in the curriculum, and merely teaches the pupil to deal with routine problems, rarely achieves any success. From the teacher is demanded enthusiasm for his subject and the conviction that his subject is one of the most important affairs of the nation. From the teacher is demanded that he implant in the students a love for mathematics and a conviction of their creative powers in the subject; that he describe, in general outline before their intellectual gaze, the impressive picture of the uninterrupted

Harold F. Fehr is Head of the Department of the Teaching of Mathematics, Teachers College, Columbia University, New York, New York.

development of mathematics with its limitless connections with technology, the natural sciences, and all the other manifestations of human activity.

We cannot *demand* this from our teachers, but we can *hope* they will achieve a similar point of view. We need quality teachers.

In the curricular reform in our school mathematics, the important consideration then is the availability of teachers able and willing to offer instruction in the subject matter included in the curriculum, and to give it the spirit of contemporary mathematical thinking. Only if the teachers find recommendations of mathematicians and educators worthy of favorable consideration, only if they wholeheartedly accept them as having a large probable validity, and only if they undertake to implement them in their classroom teaching can a modern program of mathematics education be changed from a paper formulation to a practical reality.

Many teachers are convinced that such arguments that have been advanced by groups and individuals interested in curricular reform are valid, and that modernization of the curriculum is not only in order but long overdue. They genuinely wish to bring their programs of teaching up to the highest possible standards. At the same time, they exclaim, "Who is sufficient for all these new things." We must help them to become sufficient if we at the collegiate and graduate level are to meet our responsibility.

Only a small percentage of in-service teachers can possibly have had the up-to-date training required for the task. Only those who have begun their teaching careers recently have had an opportunity to take courses modern in content and point of view, and even most of these teachers have had collegiate mathematics of a most traditional character. It is very difficult to make changes in educational procedure. It is easy to teach what we were taught and to teach it in the way we were taught. Most teachers teach what is in the books in the way it is presented in the books. To effect a change, we need the cooperation of mathematicians, educators, and teachers in producing new courses and new teaching material.

The Present Teacher Education Program

The present training of high-school teachers of mathematics needs drastic revision. The following is a typical program for a major in the teaching of mathematics. He is required to present a minimum of three years of high-school mathematics for entrance to the program. Even if he does present a fourth year of high-school mathematics, he is required to repeat most of this work in his college courses. The college course consists of a freshman year devoted to college algebra, trigonometry, and analytic geometry either as separate courses or as a so-called unified course of these three areas of study. The second year is devoted to the usual course in differential and integral calculus. The third year offers a half-year course in modern geometry, that is not modern and most of it alien

to the contemporary concept of geometry. The other half of the year is given over to theory of equations, which is of little value either for further study or for interpreting the high-school algebra. The fourth year may or may not extend the study of mathematics, since the student is now busy with practice teaching and other subjects; but, if anything is studied, it is history of mathematics, advanced calculus, or a first course in differential equations. Frequently the high-school teacher of mathematics has never gone beyond the study of calculus and at present more than 25 per cent of the high-school teachers of mathematics in the U.S.A. have never completed a course in the Calculus. In all this collegiate study, there is not a trace of modern symbolism, modern mathematical logic, or newer fields of mathematics.

If these teachers go on to the study for the Master's degree, they are caught in a dilemma. The courses offered in the faculty of pure science are usually too advanced and pointed only toward research in pure mathematics. They are not suited to the needs of the high-school teacher. If he takes a Master of Arts in Education, he obtains no study of mathematics, merely more psychology, guidance, administration, curriculum, philosophy, and methods. Since there is no obstacle to the pursuit of this degree, even though he does not get what he needs, the dilemma of the prospective teacher in most cases is resolved in favor of straight professional educational courses.

A Proposed Program

To remedy the situation, we need a program in mathematics at the collegiate level that is modern in spirit, related to the high-school program, and one which reflects the high-school preparation without repeating it. The study of college mathematics should begin with a course in analytic geometry and the calculus running for one to one and one-half years. A teaching major can then be rounded off by the study of eighteen semester hours beyond the Calculus. This work should include a study of modern algebra both of the polynomial type, and the abstract approach through the study of matrices, groups, rings, fields and a study of geometry from the real number approach, including projective, affine, Euclidean and non-Euclidean aspects. This would be truly collegiate geometry. (The synthetic approach to geometry, involving as it does so many subtle and difficult logical details, can well be left for graduate study.) Another required year of study should be Probability and Mathematical Statistics. Other courses from which selections can be made are Differential Equations, Theory of Numbers, Mathematical Astronomy, Advanced Calculus, Symbolic Logic, and Finite Mathematics.

All of the proposed courses, while essentially textbook in nature, should be accompanied by assigned collateral readings from periodicals and reference books. This required reading is absolutely essential to the development of scholarly teachers who must come to know that the

textbook is only a part of any study, either in high school or college. The work at all times should be related, when the relation is pertinent, to the high-school program in mathematics. But even this is not sufficient. In the course in methods of teaching mathematics, which should be taught by a person competent in mathematics, the high-school material should be enriched by continuous reference of it to the advanced treatment of the same material that takes place in collegiate study. This should enable the student teacher to teach correct mathematics, but not necessarily rigorous mathematics.

If a teacher continues his study toward a Master's degree, he should pursue at least 15 more semester hours of mathematics. Among the courses should be a year of professionalized high-school mathematics, illustrated by the work of Felix Klein, *Elementary Mathematics from an Advanced Viewpoint*, but treating the concepts and spirit of contemporary mathematics. Other courses should include those mentioned before, but not elected in the undergraduate program, Real Functions, Calculus of Finite Differences, Numerical Analysis, and a course in Applications of Mathematics to the Physical and Social Sciences. A real essential of the program is a seminar in mathematics education in which the problems of teaching, including curriculum, methods, testing, and the use of teaching materials, are examined in detail.

The major problem in effecting a change in the high-school teaching of mathematics is the mathematical re-education of those teachers now in service. This group is by far the greatest of all those who will effect mathematics teaching at the high-school level during the next ten years. During these years, we can also expect the greatest shortage of qualified teachers of secondary-school mathematics. Hence, good teachers should not be removed from the classroom. Summer programs and, during the year, evening or Saturday programs will suffice for retraining if we can only interest and reward the teachers for the time thus spent.

These in-service teachers, for the most part, know how to teach. They need to be up-graded in modern collegiate subject matter, and shown how to up-grade the subject matter they teach. Giving these persons courses in topology, measure theory, theory of functions, theory of games, and so on is not the answer. These teachers have been away from the classroom study of advanced mathematics for years. In fact many of these teachers have forgotten to study on a concentrated basis, and most of their college mathematics is rusty. For these teachers, there should be abbreviated courses in each of the following areas, in which the teacher should make himself a master of the basic elements and their relation to the high-school mathematics program.

1. Modern analysis including concepts of variables, function, relation, mapping, sentences, propositions, and point-set theory. Especially the setting up of functions and their inverses.

2. Modern algebra including matrices, groups, rings, fields, number systems, Boolian algebra, and vectors, and also polynomial algebra.
3. Modern geometry and its foundations and the study of several types of geometries including a finite geometry.
4. Symbolic logic, axiomatic foundation, and nature of proof.
5. Probability, including combinational analysis of both finite and continuous variables.
6. Mathematical statistics, stressing statistical inference, tests of hypotheses, and correlation theory.

The Commission on Mathematics of the CEEB and Teacher Education

R. E. K. ROURKE

TEACHER education in mathematics should have three objectives: *first*, to develop in the teacher a valid and effective understanding of the nature of mathematics; *second*, to familiarize him adequately with the subject matter of the field, particularly with those parts he will be called upon to teach; and *finally*, to equip him with a sound and effective methodology and teaching techniques. In other words, teacher education must deal with philosophy, subject-matter and methodology.

Not the least important of these is philosophy. One of the major shortcomings of mathematical instruction at present is the inadequate understanding of the nature of mathematics held by many teachers.

The popular conception of mathematics, probably shared by most teachers, is well epitomized by the catch-phrase, "Two and two are four," proverbially cited as an example of a typical mathematical truth. But in fact this phrase is an extremely poor illustration of a mathematical truth, and reflects a mechanical, computational view of the nature of mathematics that is both erroneous and harmful.

The essence of mathematics is not computation, and the nature of mathematics is anything but mechanical. Mathematicians do not spend their time grinding out specific facts nor routine deductions. Imagination, abstraction, and generalization are characteristic of the nature of mathematics; as a philosopher of a bygone generation once observed, deductive reasoning is but the pavement on which the chariot of the mathematician rolls.

But the statement: "Two and two are four" involves no imagination, abstraction of a low order, and no generalization at all; it does not even

R. E. K. Rourke, Executive Director of the Commission on Mathematics, 425 West 117th Street, New York 27, New York.

involve reasoning, but is essentially a matter of definition. Of course it is universal and immutable, but so is every truly mathematical statement.

A reasonably good illustration of a typical mathematical statement, chosen from arithmetic, might be: "Every integer can be resolved into prime factors in one and only one way, apart from the order of the factors." This is general: it applies to every integer. It is a statement whose meaning can easily be made clear, but whose truth is far from obvious. It involves mathematical imagination; some vision is required to conceive of the integers as constructed out of prime factors. And of course it is universal and immutable. Moreover, although quite abstract, concrete illustrations can be provided generously and without effort, once the term 'prime factor' is understood; and finally, it lies at the root of several important computational skills and rules.

Many other illustrations might be cited; the point is that adequate and effective teacher education is possible only if the program rests upon a valid conception of the nature of mathematics. If mathematics on any level is cenceived of as a purely mechanical skill, like typewriting, that can be learned by practice and drill, and can be transmitted by anyone who knows it to a neophyte by showing him the procedure and drilling him, no effective program of teacher education can be constructed.

Too often the nature of arithmetic has been so conceived; the multiplication tables are to be learned by rote, just as the proper finger for each letter on a typewriter is to be noted and its use made habitual by meaningless drills such as asdfg hjkl;. (This analogy may be unfair to the study of typewriting, for even here relationships are emphasized in a limited way.) Anyone who has learned to compute can, with proper methodology, teach others to compute; no background of understanding is required.

Similarly, algebra has been thought of as a collection of computational tricks or manipulative devices, with the result that the outcome of instruction in algebra has merely been to enable the pupil to solve problems that resemble sufficiently closely the typical examples solved in the textbook or the classroom. Even geometry has been reduced, in too many instances, to rote memorization of theroms and their proofs.

The first requisite for an adequate and effective program of teacher education is the complete abandonment of such views with respect to any level of education whatever, from kindergarten to graduate school. A teacher of mathematics must understand the nature of the subject whether he is teaching "counting numbers" to first-grade pupils or linear algebras to graduate students. Mathematics is not the study and memorization of computational or other tricks once for all worked out in the past and transmitted from generation to generation. It is the imaginative, creative study of "pattern," of regularity in phenomena that can be recognized by the human mind; it involves abstraction and generalization. One must understand the nature of the subject before he can teach it. This is the first great task of teacher education in mathematics.

The second is easier: to give the prospective teacher knowledge of subject matter. Here we must only agree how much background knowledge is necessary in order that one may teach effectively at any specified level, and then provide the necessary time and appropriate courses in which this knowledge may be acquired.

Finally, adequate and effective teacher education must deal with the problem of the learner: how pupils grow and develop; how they (or adults) learn; how to select appropriate material for appropriate objectives; how to present it; how to evaluate what has been done; and the like. No one can teach effectively if he does not understand the psychological nature of learning nor how the objectives he seeks may be attained.

Specifically, the irreducible minimum of background knowledge for any teacher whose duties include mathematical instruction on any level, including elementary-school arithmetic, would seem to be three years of modern college preparatory high-school mathematics. Without such a course or its equivalent, it would seem to be quite impossible for a teacher to have any adequate understanding of the nature of mathematics, and to teach in any but a meaningless mechanical manner.

In the college training of an elementary-school teacher, this background should be supplemented by a course in arithmetic taught on a college level, including the nature of the number system, the axiomatic formulation of arithmetic and an introduction to the theory of numbers.

This, it should be noted, is a course in mathematics, not a course about mathematics, such as is often given under such a title as "Social Uses of Mathematics." There is no objection to such a course, and undoubtedly some value in it, but, if given, it should be included in addition to, not in substitution for, the course described above.

Neither is the above course a course in "The Teaching of Arithmetic," nor does it afford the training in methodology needed by an elementary teacher or the professionalized review of the content of elementary school arithmetic that this latter course should provide. Such a course devoted to professionalized subject matter and methodology is also essential.

It is recognized that these requirements call for a substantial increase in the time in the elementary-education curriculum to be devoted to mathematics, especially as the proposed high-school prerequisites will have to be made up by college work in many cases until appropriate entrance requirements can be imposed and enforced. One can only say that, fortunately or unfortunately, these educational experiences are essential, and, if mathematical instruction in the elementary school is to be improved, the time will have to be found. Mathematics is by its very nature a sequential subject, and one in which short cuts simply do not exist. Its importance in our present-day civilization is such that it cannot be neglected.

Teachers of mathematics at the junior high-school level should be regarded as secondary-, rather than elementary-school teachers, and

their background should be more extensive than that described above. It would be most desirable for such prospective teachers to receive the same preparation as that to be suggested presently for senior high-school teachers, but it is possible to arrange special curricula for prospective junior high-school teachers or to prepare such teachers by supplementing the education provided in the elementary curriculum.

In addition to arithmetic, a junior high-school teacher must teach informal geometry, descriptive statistics, and some algebra. From the point of view of later work in mathematics in senior high school or college, the most important service the junior high-school teacher can render is to develop informal but accurate notions about concepts that will be more formally treated later. Thus, in junior high school, pupils should get clear and accurate informal ideas of such geometric concepts as triangle, quadrilateral, parallelogram, circle, cube, cylinder, sphere, and an inductive development of the facts concerning measurement of these and other figures, including line segments.

Clearly these goals can be accomplished only by teachers who thoroughly and accurately understand the ideas that they are teaching. Hence, in addition to the understanding of numbers and number systems required by elementary teachers, junior high-school teachers need courses in geometry, algebra, statistics, and calculus.

It is to be hoped that a prospective junior high-school teacher will have had a full four-year modern secondary-school course in mathematics. He can then study calculus and analytic geometry during his freshman college year, and easily cover the other minimum mathematical requisites in two additional years of study. Without the fourth year of high-school mathematics—or if this were an old-fashioned course—an additional year of college work would seem to be necessary.

A course in "The Teaching of Mathematics in the Junior High School" would seem to be quite as essential as the courses in mathematical subject matter. The manner in which the concepts of mathematics that the prospective teacher has studied in his content courses are to be adapted without loss of accuracy or correctness to the much lower level of maturity, abstraction, and precision appropriate for pupils in the junior high school or upper grades can hardly be left to the neophyte to discover for himself. Such adaptation is a problem of mathematical pedagogy of no little difficulty and importance.

For prospective teachers of senior high-school mathematics, a college major in this subject is regarded as the minimum essential if the teacher is to be prepared to handle comfortably and competently the full range of senior high-school courses. Such a major must include work in analysis, algebra, geometry, and statistics. Courses in fundamental concepts and logic are highly desirable, and as many other mathematical electives as possible should be included. In particular, a first course in calculus must be regarded either as preliminary to the major or as the first course in

the major; it should never be thought of, as too often in the past it has been, as the climax of the prospective teacher's preparation. It is the beginning, not the end.

A course in "The Teaching of Secondary Mathematics" is also essential. This course should trace enough of the history of the teaching of mathematics in the United States to provide background material for understanding present-day pressures for curriculum change. Following this, there should be a detailed discussion of some of the principal ideas of modern mathematics in the light of secondary-school teaching. An additional objective ought to be to bring home to the teacher that his professional education has not been completed in his college course and that he must look forward to continuing study while he is actively engaged in his profession.

Such continuing education should involve both additional work in education and in mathematics itself. Without doubt a teacher should understand the history and philosophy of education, particularly public secondary education, and many other similar matters of professional concern; it is certainly not essential and probably not desirable that all of this work should be covered prior to graduation from college and entrance upon a teaching career. In the graduate school, the experienced teacher can profit from an advanced seminar in the problems of secondary education and the teaching of mathematics. Certainly there is a great deal of available material on the teaching of mathematics that is of value to the experienced teacher. Furthermore, it is always helpful to exchange points of view on the many problems encountered in the classroom.

But graduate work should not be confined to this area. Mathematics itself is a subject that has developed greatly and changed markedly in the last generation. There is every prospect that this research dynamism will continue. Moreover, the applications of mathematics are becoming ever more extensive. Fields hitherto largely non-mathematical are beginning to utilize mathematics quite extensively. Many new vocational opportunities are available to mathematically trained persons. Teachers need to keep up with all of these developments.

To make it possible for teachers to do so, colleges and universities have an important adjustment to make. Too often these institutions have placed teachers and future research mathematicians in the same graduate courses. This practice is both unwise and self-defeating. It is unwise because the objectives of the teacher and the objectives of the research mathematician are not the same, and can rarely, if ever, be served in the same course. It is self-defeating, because teachers, finding the graduate courses in mathematics unsuitable, elect instead courses in other fields—usually education—which may be equally unsuitable, but at least can be successfully completed. Cooperation of both departments of mathematics and schools of education is needed in setting up appropriate graduate courses with suitable objectives, realistic prerequisites, and challenging content. Happily there are signs that such cooperation is increasing.

MINIMUM ESSENTIALS IN THE PROFESSIONAL EDUCATION OF A PROSPECTIVE TEACHER OF MATHEMATICS

Subject	*In the Elementary School*	*In the Junior High School*	*In the Senior High School*
High-School Mathematics	3 years	4 years	4 years
College Mathematics	6 hours (Numbers and Number Systems)	18 hours (Calculus and Analytical Geometry; Algebra and Number Theory; Geometry)	30 hours (Calculus and Analytical Geometry; Analysis; Abstract Algebra; Geometry; Statistics; Logic)
Mathematics Education	3 or 4 credit hours (Teaching of Arithmetic)	3 or 4 credit hours (Teaching of Junior High-School Mathematics)	3 or 4 credit hours (Teaching of Secondary-School Mathematics)

General education courses, minors, and professional courses in education are not shown in the above chart, but it is assumed that adequate attention will be paid to these aspects of the college program also.

In addition to formal graduate work there are many other opportunities for continuing in-service education of teachers: Conferences and institutes, professional meetings, study groups that call for meetings once a week, or every two weeks, or once a month or even programs of independent reading and study.

School administrations and school boards should not only encourage, but also expect such activity, and—even more important—should make it possible by refraining from assignments of excessive teaching loads or non-teaching administrative, committee or extracurricular duties, by providing reference libraries for teachers, by providing released time and travel funds for attendance upon professional meetings, and by improving the attractiveness of the profession in every possible way.

One of the best ways to secure a continuing high level of instruction in mathematics is to assemble a teaching staff each member of which keeps up by reading, study, and discussion, and by attendance upon professional meetings, with new developments in mathematics, its applications, and its teaching. These things can be done only by teachers with both leisure and peace of mind. A harried, distracted, worried teacher cannot study mathematics; such study demands intense concentration, reasonably large blocks of uninterrupted time, and continuous attention. One cannot read a book in mathematics, as David Livingstone is said to have accomplished in his boyhood reading, by tying the book to the shuttle of a loom, and catching a word or two as the shuttle passed by.

Neither can it be successfully accomplished at the end of a hard day by teachers tired both in body and in mind.

What has been set forth is a statement of what in all conscience should be the minimum preparation of teachers of mathematics. But it must also be recognized that in fact, in many small schools (and some not so small), scheduling or other administrative problems make it necessary for teachers to teach classes in fields in which they have minor certification only, and in which they are in no sense fully prepared. It must also be recognized that in fact there are now in service many teachers who never had the preparation we have advocated, even though mathematics may be their major area of certification, and, moreover, many whose preparation is sadly out of date from the viewpoint of modern needs. What should be done with respect to these hard realities?

First, administrators should make every effort to reduce to a minimum the assignment of work to teachers in outside fields in which they are not fully qualified. Often this is accepted as the easy solution to a difficulty, (after all, it is legal), when a little more determined effort could solve the administrative or schedule difficulty more satisfactorily.

Second, adequate programs of in-service education or re-education should be set up or authorized for teachers who are teaching minor fields to acquire the education hitherto not obtained, and to bring up to date those whose preparation, though once perhaps adequate, has now become old-fashioned. Such programs would be completely appropriate within the framework of continuing professional education described above.

Finally, in all practical situations there must at times be improvisation. One can rarely if ever attain wholly any ideal that may be set up as a goal. But this does not excuse either failure to set up a worthy goal, nor genuine efforts to attain it. Indeed, only so can compromise and improvisation be justified.

Academic Year Institutes

BURTON W. JONES

SINCE 1953, the National Science Foundation has supported Summer Institutes in mathematics and science for college and secondary-school teachers, as part of its national effort to increase the science potential of this country. More recently, the Academic Year Institutes were established with the same general purpose in mind, but also to afford a somewhat smaller number of teachers an opportunity to benefit from more intensive study over a period of nine months so that, with better knowl-

Burton W. Jones, Department of Mathematics, University of Colorado, Boulder, Colorado.

edge of their fields and the new viewpoints therein, they might communicate their understanding and enthusiasm to their students. Not only was it felt that the effect on the secondary-school teachers (and their students) would be good, but also that the universities offering such programs would be encouraged to develop courses in subject matter especially suited to these teachers.

The first two Academic Year Institutes were in 1956-57 at the University of Wisconsin and Oklahoma A. and M. College (now Oklahoma State University). In the year 1957, there were fourteen such Institutes in addition to the two original ones. They were located at the following institutions: Harvard University, Ohio State University, Oregon State College, Pennsylvania State University, Stanford University, Washington University, and the Universities of Chicago, Colorado, Illinois, Michigan, North Carolina, Texas, Utah, and Virginia. In 1958-59, all of the above institutions except Stanford University have such Institutes, and in addition there are Institutes at the University of Pennsylvania, Iowa State Teachers College, the State University of South Dakota, and Syracuse University. It seems likely that there will be about thirty Academic Year Institutes in 1959-60.

Each Institute has about fifty participants each of whom receives a maximum stipend of $3,000 plus tuition costs and allowances for dependents, books, and travel. The institutions are reimbursed for some of the cost of instruction.

Though it is difficult to assess the long-range effect of these Institutes, there is every indication from all concerned that they are being highly successful. Part of their success is due to factors that were perhaps not completely visualized at their inception. Most institutions involved have set up special Master's degrees or adapted those already in force—degrees that are not merely stepping stones on the way to the doctorate, but which certify achievement in subject matter and freshness of point of view appropriate to secondary-school teaching. Many of the participants have gained renewed interest in the subject matter itself and a feeling of confidence in dealing with it, as well as an appreciation (sometimes dimly remembered) of what it is like to be a student. Moreover, those in the universities involved have become acquainted with some of the problems and needs of the teachers and how they can contribute to their assistance. The participants in the Institutes have the opportunity to compare notes and problems with their colleagues, and those in the universities have worked together in developing programs cutting across departmental lines. Every indication is that these Institutes are fast becoming one of the important influences for the good in the field of science education.

One indication of the effectiveness of this program has been the enthusiasm displayed by principals and other administrators in encouraging their teachers to attend these Institutes, in the face of the difficulty

of finding replacements for the year; for it has quickly been evident that not only is the individual teacher benefited and the effectiveness of his teaching increased, but also his colleagues are inspired by his experience and enthusiasm.

Each year in the past, the latter part of December or the first part of January, the National Science Foundation has issued a pamphlet describing the program and listing the universities where such Institutes will be held the following year. Candidates for stipends should write the Foundation for this pamphlet (the address is Washington 25, D. C.), select the institutions where they wish to apply, and write for information and application blanks from each. Standards of admission vary somewhat from institution to institution, but within the following policy described by the Foundation in its most recent pamphlet:

> Admission to the various Institutes will be controlled by the requirements of the schools involved, each having somewhat different criteria for admission to the Graduate School. The Foundation has established the policy that candidates shall be considered primarily on the basis of professional competence and promise as teachers of science and/or mathematics. These Institutes have been designed to provide the type of supplementary training in the subject matter of science needed by the typical high-school teacher with little or no more formal education than that represented by a bachelor's degree. The selection process is, therefore, likely to favor such applicants as contrasted with those who have already completed work for a master's degree in science.

Another factor in the selection process is often the interest expressed by the individual and his principal in the introduction of changes in material and viewpoint into the curriculum as well as the existence of other conditions favorable to such changes. A great many applications are received, and teachers are urged to apply as early as possible.

Industry Lends a Hand

G. A. RIETZ

THE title for this section seems quite appropriate as it suggests the role as well as proper approach of industrial organizations in educational relations activities. In the first place, business organizations are not educational institutions. Therefore, their proper attitude is one of determining how to work with and through our existing educational institutions to assist in improving educational results. The activities and offerings of industrial concerns should reflect an understanding of some of the critical educational problems and the supplemental efforts of industry which are appropriate and in areas that can most effectively contribute to improve-

G. A. Rietz, Consultant, Educational Program Development, Educational Relations and Corporate Support Service, New York, New York.

ment and progress. These are offered to educators and institutions, clearly recognizing that they will select those which the individual teacher or school system feels will be most helpful in accomplishing its work. As corporate citizens, most industrial organizations look upon this as necessary and appropriate activities by responsible members of modern society.

Industry's Awakening

It was fairly common some years back, to find industrial organizations active in educational programs at the graduate school level and to nearly the same extent at the undergraduate college level. General Electric was among the first to recognize the secondary-school level as perhaps the most critical "bottleneck" to the supply of well-educated manpower in all fields and professions. Although "The House of Magic," a traveling science show, was developed as an aid available to secondary schools in the early 30's, a well-balanced company-sponsored program for the secondary-school area started about 1945.

New programs were then inaugurated by the company which provided secondary-school teachers with opportunities to upgrade their subject matter knowledge and experience and also offered them aids to teaching and guidance of their pupils. In addition to the enlarged schedule of secondary-school showings of the "House of Magic," publications especially prepared for secondary-school pupils in the fields of mathematics, science, engineering, guidance, *etc.* were offered teachers. The acceptance by junior and senior high-school teachers was immediate and enthusiastic. The booklets were offered free of charge in classroom quantities on direct request by the teacher. One indication of the uses teachers found for such aids and their appraisal of their value is the fact that since 1945 they have requested about 110 million copies. For example, something over 5 million copies of *Why Study Math* and 1½ million copies of *Math at General Electric* have been furnished to secondary-school teachers, on request, for classroom use. Incidentally, others have found these publications valuable in educational areas; permission to reprint *Why Study Math* and *Why Study English* has been given to at least 100 professional journals, company house organs, teenage magazines, textbooks, and so forth. Some of the publications have also been circulated abroad, usually in translation, in a dozen or more foreign countries.

Some Results

A rather effective measure of impact on students has been made on a continuing basis. Periodically since 1946, an experienced outside survey organization has appraised changes in opinion among secondary-school students coast to coast. Among noticeable changes are the student's answer to this question: "What school subjects do you think will best fit you for your career?" The 1957 results show that students select mathe-

matics as being of first importance, English second, followed closely by high-school science. Each of these three has gone up from double to 2½ times the percentage of frequency of first choice by students since the original survey in 1946. We believe that the use teachers have made of these publications, as well as of our "Progress Posters" and similar industry aids, has made a major contribution to such changes in the attitudes of secondary-school students.

First Program for Secondary School Teachers

In 1945 General Electric also started its present summer fellowship programs for secondary-school teachers at cooperating universities. Whenever we asked high-school science or mathematics teachers what additional things would enable them to do a better job of teaching pupils and interesting more pupils in high-school science and mathematics courses, their reply was usually a two-part one. First, they said they needed to know more about the subject they were teaching. Second, they said they needed also to know how such subject matter was going to prove to be useful to the boys and girls in later life. Analyzing this two-part answer identified the first as a responsibility of a college or university—to educate in subject matter content; whereas the second could best be provided in a realistic manner through exposure to a large industrial organization or employer of graduates of schools and colleges. This naturally suggested a joint undertaking by an interested college and General Electric where the two were located in the same community.

In the summer of 1945, General Electric and Union College in Schenectady arranged for 50 high-school science teachers from about a dozen states to take a six-weeks all-expense graduate credit course in physics or chemistry at the college, to be supplemented by a "laboratory program" conducted by General Electric. The results of two years were so outstanding that in 1947 a similar program was added at Case Institute in Cleveland, utilizing General Electric facilities of the Lamp Division. Shortly thereafter, similar programs were developed for secondary-school mathematics teachers. During recent summers, 150 secondary-school teachers of mathematics are taking such programs at three American universities, and another 150 secondary-school science teachers are at three other colleges. Some 2,200 teachers in 38 states and the District of Columbia have been graduated from these programs during the past 14 years.

Teacher's Appraisals

Typical of the independent appraisal by teachers is the following quoted from an article in the April 1958, issue of the *Kansas Teacher*, written by two mathematics teachers from Kansas who attended the G. E. Stanford mathematics program in 1957.

Now that we are back in Kansas. . . . what have we learned and how can we use it? Probably none of us will ever know the complete answer to that, but we do know a few parts of the answer. In the first place, General Electric expects us to return to our classrooms and do a better job of preparing students than ever before. . . . We can only say that our entire philosophy has undergone a "face lifting." In addition to that, students know we have had this opportunity and are therefore disposed to listen to us in a *bit* different way. Nothing speaks to you like firsthand experience. "Anybody can read it out of a book."

Direct reference to some feature of the program has been made almost every day. Many more times the way something is explained, the manner of presentation is tinted by the experience of having worked under master teachers. The experience of having been in the classroom of an expert colors one's feeling toward his students.

As long as we keep trying to the best of our ability to train young people to be accurate, neat, and dependable, we will be making application of our summer's work. As long as we try to point the way through training in subject matter, through personality development, through information on job opportunity, we will be helping repay General Electric for a most rewarding summer.

Other participating mathematics teachers have written such appraisals as:

I have always been convinced of the values of mathematics, but now I find it easier to convince the students of them too.

It was packed with experiences that will enrich not only my teaching but my own life as well for many years to come. It was one of the most vitalizing experiences I have ever had.

University Appraisal

The appraisal of cooperating universities is typically stated by Dr. E. B. Allen, Head of the Department of Mathematics at Rensselaer Polytechnic Institute, who directs the G. E. Rensselaer Summer Mathematics Teachers Fellowship. He sums up the program as:

1. To stimulate enthusiasm for courses in mathematics on the part of students and officers of public instruction.
2. To familiarize teachers with some of the important applications of mathematics.
3. To furnish teachers with mathematics information which may be of assistance in their teaching and in the guidance of their students.
4. To foster growth in the mathematical knowledge and background of the participants.
5. And, in general, to aid these teachers in every possible way to make their secondary-school mathematics courses of vital interest to the students.

This brief outline must, of necessity, leave untouched many facets of the General Electric Mathematics Fellowship program, but perhaps it is sufficient to indicate the interest of the General Electric Company in problems of education and its willingness to assist in solving them. To us, as mathematicians, it should be a source of encouragement to know that our science is recognized as of prime importance by a leading industrial organization.

Long-Time Impact

That such a summer's experience equips and motivates the participating teachers on a short-time basis perhaps is not surprising. We felt it was important to determine whether this impact on the teachers, and thus on the students, persisted over a long period of years. Last winter an appraisal questionnaire was sent to principals or supervisors of secondary schools in whose systems one or more teachers had been teaching at least five years (5-8 years) since their summer on a G. E. program. Four hundred and sixty-five principals replied. Their appraisal can be thus summarized:

1. The program meets a basic secondary school need through upgrading knowledge of subject matter and development of more stimulating teaching.
2. More students are enrolling in the participant's courses—except where laboratory and class facilities are restricted.
3. Recognition as a G. E. Fellow has often been a prelude to further scholastic honors and distinctions, qualification for promotion and higher salaries.
4. Guidance programs have been stimulated by increased knowledge of business life received by teachers through lectures, plant visits, and other company-sponsored experiences.
5. "Living" with other school teachers tends to strengthen the resource of participants when they return to the school.
6. Such a combination of academic sessions with industry-related participation clearly appears to be the best type of summer experience for secondary-school teachers.

About 2,200 teachers have held the Fellowships to date, and an estimated 1,500,000 students have profited by their teachers' experiences.

The Idea Spreads

Often an educational program pioneered by an industrial organization serves the added function of concentrating rather broad attention on an educational situation that should be changed. For example, at the time General Electric pioneered summer programs for high-school teachers, mathematics and science departments of colleges were not offering summer school courses in subject matter that met the needs of secondary-school teachers. As a result of developing special courses in cooperation with selected universities, it became obvious to many other universities that they should be offering special summer courses for such secondary-school teachers. Slowly at first, and then more rapidly, not only did one observe more colleges releasing summer school bulletins offering courses in subject matter especially for teachers, but also other industries, and then the National Science Foundation started sponsoring teachers to take such programs. These do not provide the teacher with the industrial experience which is still distinctly associated with the General Electric sponsored summer programs.

Another Mathematics Teachers' Program Started in 1958

In the summer of 1958, we embarked on an additional and somewhat different program for mathematics teachers. It was obvious that any of the summer fellowships provided teachers with considerable additional experience and knowledge with which to improve their performance. However, especially in the field of mathematics, high schools are attempting to introduce more advanced courses and some of the more modern mathematics into the curriculum. Progress will probably be limited by the number of qualified teachers for such courses. Quite obviously the supply of qualified teachers will not meet the demand unless new programs which enable the teacher to spend additional summers in advanced college courses are made possible. Through the mathematics department of Purdue University, we are sponsoring 15 graduates of our summer mathematics fellowship programs to take additional work and eventually secure their Master's in the teaching of mathematics. Already there has been some limited adoption of this by other companies, and we are hopeful that the National Science Foundation and others will support mathematics teachers who will continue their studies and be ready to fill the need for highly qualified secondary mathematics teaching.

Any of us involved in educational relations activities are constantly studying and experimenting with possible new ventures or methods that appear to offer possibilities of continued improvement in educational results. Some types of programs more nearly match the philosophy and policies of one company than they do another. Also it is evident that each company is able to finance only a limited number of programs that have merit, and further, it is desirable that there be a variety of programs and aids available to education rather than that they all be alike.

The obvious conclusion is that American industrial organizations are in general convinced of the importance of good education to the progress of society as well as to their own company. They are, therefore, devoting not only money and manpower, but also serious study to the activities that it is appropriate for them to sponsor, in the manner that best fits their policies and philosophy, and most effectively contributes to the solution of the more important educational problems. This approach suggests that new programs and activities will be forthcoming; that changes will occur as judgment seems to indicate they are called for to answer new or newly recognized problems. This seems to be the most constructive way in which industry can lend a hand on an appropriate and constructive basis.

A University Assists in an In-Service Program

ROBERT DAVIS

THE present note is a brief description of what has come to be called "The Syracuse Plan." This plan consists of several parts, intended as an attempt to modify the very institution of the secondary school in America, but we shall here consider only a single aspect of the Plan, that which relaxes to release-time study.

What Is the Plan?

The "release-time study" feature of the Plan provides that teachers will teach one half of their normal teaching loads (or thereabouts), will study one-half time at a nearby University, will receive their usual full-time salary, and will not need to pay for the costs of tuition.

From the teacher's point of view, then, his financial position when participating in the Plan is exactly what is was before he began to participate, and exactly what it will be after he ceases to participate in the Plan—that is, at each year he receives the same salary he would get if he taught full time, and he is not required to pay tuition. What *is* different is that he teaches only one-half time, and studies at a University one-half time.

The scheduling is usually arranged so that participants teach mornings at their regular school jobs, are released around eleven o'clock, and study afternoons at Syracuse University. Participation is limited at present to teachers of mathematics (grades 7-12) in communities near to Syracuse University. At the moment, six communities have teachers participating in the Plan, which can accommodate between ten to twenty teachers at a time. Participation by each teacher is normally for one year, but may be extended to one or more additional years if the teachers, the university, and the community school system agree to do so. If not, at the end of the year of half-time study, the teacher will return to full-time teaching and (perhaps) some other teacher from the same schools system will begin a year of half-time teaching and half-time study.

Which Teachers Are Selected for Participation?

It is easy at first glance to overlook the real meaning of this Plan, but we can attempt to avoid this by emphasizing its distinctive features. One such feature relates to selection of participants. If this were a method for providing minimal training for marginal teachers, it would, in our view, be commonplace. It is not. On the contrary, the teachers selected as participants are in every case among the strongest and best teachers in their respective systems. Among school systems themselves, it is the dynamic, high-quality system that is especially sought after as a partner in the Plan. The concern here is with excellence, and the goal is to make the

Robert Davis, Department of Mathematics, Syracuse University, Syracuse, New York.

best even better. The reason for this emphasis will be made clear in a moment.

Who Pays for the Plan?

The additional costs of the Plan are two: *first,* the teacher is paid for an afternoon of study, which represents a new expense; *second,* the university offers instruction to these teachers, and must receive tuition for doing so. Notice that the cost of the half-time morning teaching is not a new or additional expense. This activity is paid for just as it normally would be if the Plan were inoperative. The only new or additional expenses are tuition and pay for afternoon study.

At the present time, tuition is paid under a special grant from the Alfred P. Sloan Foundation, and the additional salary expense is split between the participating community and the Foundation grant. The cost to the grant is about $40,000 annually, and the cost to all cooperating school systems together adds up to something less than an equal amount. Thus private funds, at the moment, bear slightly more than one half of the cost. This is felt to be important at a time when a new precedent is being established in the use of public tax money by school systems. The school gets something more than two dollars of return from every dollar that it puts up.

To summarize then: a participating teacher would teach at his usual job each morning until about eleven o'clock. At this time he would leave for the day, and would spend the afternoon studying at the university. He would continue this for a year, and possibly might continue for several years. He would receive his usual full-time salary, and would not be required to pay tuition. The full cost of tuition and one quarter of his salary would be paid by a grant from the Sloan Foundation. Three quarters of his salary would be paid by the school where he teachers one-half time. Thus both school and Foundation contribute to the extra costs of the half-time study (the school contributes by paying three-fourths salary for half-time work).

What Are the Benefits of the Plan?

That such a Plan involves complications and problems is undoubtedly clear to any reader familiar with school administration. Fortunately, the Plan also offers certain benefits, and these, in our opinion, greatly outweigh the disadvantages.

First, there are the short-term advantages. At the present time a new mathematics curriculum is being introduced into American secondary schools, under the influence of the Commission on Mathematics of the CEEB, the Advanced Placement program, the Illinois Project (UICSM) and so on. This involves a course in statistics (to replace solid geometry), and, if a school wishes to participate in the Advanced Placement program, a twelfth-grade course in college-level calculus. Moreover modern axiomatic algebra, formal logic, digital computers, and newly developed social science applications of mathematics are all leaving their mark on the modernized curriculum. Considerable additional study by teachers—

and especially by good teachers, who can provide local leadership—is urgently needed. This need is ideally answered by participation in the Plan.

Such short-range benefits are of great importance but they are not the main objective of the Plan. Its major emphasis is on long-range objectives such as the following:

1. *Eliminating premature professional deaths.* All too few teachers continue to grow professionally, and all too many come to stagnate. It is hoped that the Plan will enable more good teachers to continue their professional growth for many years of their lives. This could be its greatest contribution.

2. *Attracting better teachers.* All too often the student with a genuine (and contagious) enthusiasm for learning mathematics reasons (alas; correctly) that his opportunities to continue learning will be greater if he goes into industry or into college teaching, rather than into secondary teaching. *We need this kind of person in our schools.* There is only one way to get him there: we must transform the secondary school until it is the sort of place where such a man will choose to work. "Release-time study" is clearly a step in this direction.

3. *Developing leadership within the profession.* No profession has ever prospered when it has consisted of the numerous pawns who *do*, and the few pieces who *know*. Teaching cannot build soundly on a foundation of college experts and school system supervisors acting as generals, while the large body of teachers are regarded as enlisted men. Leadership must come from the teachers themselves, and we must not require the teacher to forsake his classroom entirely in order to become an effective leader.

4. *Focusing attention on teaching loads.* Present secondary teaching loads are fantastically and unrealistically high. By way of analogy, suppose that a major airline decided to abandon preventive maintenance and routine inspections, and re-arranged its schedules so that every aircraft was kept in use at maximum speed on a 24-hour schedule. This would be no way to run an airline. It is equally no way to run education, yet it is what we have tried to do. A much lighter teaching load—in many colleges it is six hours of classes *per week*—would allow time for continuing study, for continuing growth, for the maintenance of freshness and enthusiasm, for individual attention to students, for the development of professional leadership, for the writing (and *using*) of better textbooks, and for all the little extras that are now impossible.

Conclusion

The Syracuse Plan is an ambitious undertaking. Its local success thus far has depended on the creative administrative efforts of principals, superintendents, board members, and university representatives. Its continuing success—hopefully on a much larger scale—will continue to depend above everything else on creative and far sighted administration. In mathematics and in all other subjects, America has much to gain from the success of a plan such as this.

The Undergraduate Achievement of National Merit Scholars and Certificate of Merit Winners

JOHN L. HOLLAND

THE relative achievement of National Merit Scholars and Certificate of Merit winners is of importance since the success of these groups in their first year of college is one estimate of the validity of the selection process. The present study[1] compares the freshman college grades of the second groups (1957 Program) of Scholars and Certificate winners. The samples consist of 743 Merit Scholars (89.1 per cent of the Scholars appointed) and 579 Certificate of Merit winners (55.4 per cent of a one-sixth random sample of all Certificate winners).

In the following tables, three kinds of comparisons have been made. Table 1 shows the total distribution of grades for Merit Scholars and Certificate winners.[2] Table 2 gives within-state comparisons. Table 3 indicates the relative achievement of these groups within colleges. In all three comparisons, Merit Scholars surpass Certificate of Merit winners in their first year of college study.

Table 1 clearly indicates that Merit Scholars achieve higher grades than do Certificate of Merit winners.[3] The median test of this difference is significant beyond the .001 level for both male and female samples. The within-state comparisons of these samples are given in Table 2. Note

TABLE 1. Freshman Grades for Merit Scholars and Certificate of Merit Winners

	Males		*Females*	
Honor Point Ratio	*M.S.*	*C of M*	*M.S.*	*C of M*
3.75–4.00	100	52	44	27
3.50–3.74	94	45	39	17
3.25–3.49	84	51	31	19
3.00–3.24	76	62	25	33
2.75–2.99	44	42	19	31
2.50–2.74	53	52	20	20
2.25–2.49	41	38	7	9
2.00–2.24	27	29	6	6
1.75–1.99	11	16	3	1
1.50–1.74	8	13	1	4
1.49 or below	10	9	0	3
Total Students	548	409	195	170
Median	3.26	3.00	3.33	3.06
P diff.	.001		.001	

[1]This study was partially supported by research grants from the National Science Foundation and the Old Dominion Foundation.

[2]All grades were converted by an honor-point ratio formula where A = 4, B = 3, C = 2, D = 1, F = 0; grades were multiplied by credits per course and divided by total credits carried.

[3]Actually, Merit Scholars also receive a Certificate of Merit. In this comparison, Certificate of Merit refers to those finalists not receiving a scholarship.

John L. Holland is Director of Research, National Merit Scholarship Corporation, 1580 Sherman Avenue, Evanston, Illinois.

TABLE 1. Median Honor Point Ratios for NM Scholars and Certificate of Merit Winners by State

	Boys		*Girls*			*Boys*		*Girls*	
	M.S.	*C.M.*	*M.S.*	*C.M.*		*M.S.*	*C.M.*	*M.S.*	*C.M.*
Ala.	3.02(11)	3.29 (4)	3.52 (6)	3.24 (4)	Neb.	3.52 (6)	2.73 (6)	2.71 (3)	3.54 (2)
Ariz.	2.68 (2)	2.88 (1)	3.45 (2)	3.96 (1)	Nev.	2.85 (1)	— (0)	— (0)	— (0)
Ark.	2.31(12)	2.58 (6)	3.17 (2)	2.75 (3)	N.H.	— (0)	3.42 (1)	— (0)	2.78 (1)
Cal.	3.16(41)	3.11(28)	3.56(10)	2.61 (5)	N.J.	2.98(16)	2.65(18)	3.30 (6)	2.92 (7)
Colo.	2.67 (9)	3.35 (3)	3.78 (1)	— (0)	N.M.	3.39 (4)	1.71 (1)	— (0)	2.62 (2)
Conn.	3.15(10)	2.84(10)	3.46 (2)	2.57 (1)	N.Y.	3.33(41)	3.05(39)	3.36(19)	3.39(11)
Del.	3.25 (1)	— (0)	— (0)	— (0)	N.C.	3.43(11)	3.20(14)	3.09 (7)	3.03 (3)
D.C.	3.31 (3)	3.71 (1)	— (0)	2.71 (1)	N.D.	3.35 (3)	2.89 (4)	3.52 (1)	2.13 (1)
Fla.	3.24 (8)	2.61 (4)	2.64 (5)	3.40 (2)	Ohio	3.38(25)	3.00(23)	3.46(10)	2.83 (3)
Ga.	3.19 (6)	3.16 (5)	3.52 (5)	3.40 (3)	Okla.	3.31(11)	3.28 (5)	3.00 (3)	3.06 (7)
Ida.	3.34 (5)	2.62 (2)	— (0)	2.56 (3)	Ore.	3.25 (6)	3.53 (7)	3.10 (3)	2.74 (2)
Ill.	3.12(35)	3.00(26)	3.57 (9)	3.18 (8)	Pa.	3.15(44)	2.84(29)	3.44(11)	3.23(16)
Ind.	3.54(20)	3.51(13)	3.33 (2)	2.98 (5)	R.I.	3.22 (3)	2.34 (3)	3.79 (1)	— (0)
Iowa	3.69(14)	3.28 (5)	2.86 (3)	2.95 (4)	S.C.	3.03 (5)	2.31 (4)	2.81 (4)	— (0)
Kan.	3.78 (9)	3.15 (7)	3.20 (3)	2.72 (4)	S.D.	3.44 (2)	3.81 (1)	3.57 (3)	3.53 (1)
Ky.	3.53 (4)	2.95 (6)	3.50 (5)	2.90 (1)	Tenn.	3.00 (7)	3.09(11)	3.04 (8)	— (0)
La.	3.28 (9)	3.33 (6)	2.95 (4)	3.49 (1)	Tex.	2.96(26)	3.14(16)	2.62 (6)	3.47(10)
Me.	2.30 (3)	3.46 (3)	2.89 (1)	— (0)	Utah	4.00 (3)	3.32 (5)	3.44 (2)	3.23 (2)
Md.	3.30 (5)	3.07 (4)	3.40 (3)	3.58 (1)	Vt.	2.41 (1)	— (0)	3.38 (1)	3.24 (1)
Mass.	3.29(20)	2.73(16)	2.90 (6)	2.89 (8)	Va.	3.42(11)	2.65 (9)	2.95 (2)	3.17 (6)
Mich.	3.23(17)	3.29(15)	3.44(13)	3.08 (8)	Wash.	3.03 (9)	2.92 (8)	3.32 (4)	2.42 (2)
Minn.	3.22(11)	3.07 (6)	3.37 (7)	3.90 (6)	W.Va.	3.02(10)	2.67 (8)	3.53 (2)	3.40 (3)
Miss.	3.11 (7)	3.00 (3)	3.68 (2)	3.00 (4)	Wisc.	3.33(17)	3.30 (8)	3.91 (3)	2.98 (8)
Mo.	3.26(16)	2.97 (9)	3.72 (3)	2.79 (5)	Wy.	3.59 (2)	3.50 (1)	— (0)	2.00 (1)
Mont.	3.03 (4)	2.54 (4)	— (0)	— (0)	Terr.	3.12 (2)	1.51 (1)	3.27 (2)	3.24 (3)

Note.—Numbers in parentheses equal number of students. The number of differences favoring Scholars is statistically significant. Sign tests indicate that the number of these positive differences is significant beyond the .05 level for both males and females.

that the median honor-point ratio for Scholars is generally higher than that for Certificate of Merit winners. This result is statistically significant. This particular comparison is especially meaningful since the selection board makes its decisions about students within rather than between states; that is, it considers and compares only students within a given state.

Within-college comparisons for the Merit Scholars and Certificate winners are shown in Table 3. For ten colleges having large concentrations of students from the two groups, 12 of the 14 comparisons between Scholars and Certificate winners favor the Scholars. This result is statistically significant.

Discussion

Taken together, the results indicate that the total selection process has been effective in identifying the students who will do well in the freshman college year. This is a substantial achievement when one realizes that Scholars and Certificate winners differ only slightly in their potentials for college work and in their obtained freshman grades. This particular

TABLE 3. Within-College Comparisons for Scholars and Certificate of Merit Winners Attending 10 Selected Colleges

	CIT		*Harvard*		*MIT*		*U. of Mich.*		*Princeton*	
	M.S.	*C.M.*	*M.S.*	*C.M.*	*M.S.*	*C.M.*	*M.S.*	*C.M.*	*M.S.*	*C.M.*
3.50–4.00	1	3	15	2	13	0	2	6	6	0
3.00–3.49	4	3	20	8	14	4	3	4	7	4
2.50–2.99	8	2	13	4	9	3	1	0	5	7
2.00–2.49	3	0	8	6	9	10	0	1	6	6
1.99 or below	1	1	4	1	5	6	3	0	1	2
Total	17	9	60	21	50	23	9	11	25	19
Median	2.94	3.36	3.05	2.78	3.03	2.18	3.23	3.51	3.00	2.60

	Rice		*Stanford*		*Yale*		*Radcliffe*		*Wellesley*	
	M.S.	*C.M.*	*M.S.*	*C.M.*	*M.S.*	*C.M.*	*M.S.*	*C.M.*	*M.S.*	*C.M.*
3.50–4.00	0	2	8	2	3	1	3	0	2	0
3.00–3.49	5	1	4	4	9	7	6	2	6	3
2.50–2.99	5	2	5	1	5	11	5	6	6	6
2.00–2.49	3	1	0	3	7	3	0	2	0	1
1.99 or below	1	1	0	0	1	2	0	0	0	0
Total	14	7	17	10	25	24	14	10	14	10
Median	2.81	2.78	3.40	3.13	2.90	2.68	3.00	2.89	3.15	2.80

Note.—Female samples for four of the colleges in Table 3 have been omitted. All comparisons within these very small samples favor the Merit Scholar groups. A sign test indicates that the number of differences favoring Scholars is significant beyond the .05 level.

analysis does not enable us to distinguish the relative values of the specific kinds of information used in the selection process or to assess the effectiveness of the selection board itself. A previous report, however, has studied the relative values of the selection tests and high-school grades.[4] Other studies which will determine the relative value of the screening tests as well as of other personality and attitudinal variables are now in progress.

[4]Holland, J. L. Prediction of Scholastic Success for a High Aptitude Sample. *School and Society*, 1958, 86, 290-293.

The Administrator and the Conant Report

DAVID B. AUSTIN

A STUDY of the American High School, the project upon which Dr. Conant has been working since the summer of 1957, has reached a point in its development which compels specific and immediate attention of all who are concerned with the continuing improvement of secondary education in this country. The publication of the book[1] carrying the sub-title *A First Report to Interested Citizens* will prove a source of great interest and obligation to those responsible for the administration of our secondary schools. The use of this report effectively in improving education will not be a simple task, for it is a challenging and easily mis-interpreted document.

This is not merely another normative survey done by a weak-winged fledgling entering into his first professional inquiry nor the outburst of a superficial and ill-tempered professional critic whose evil eye falls upon our secondary schools. Dr. Conant is a serious, qualified student. He has devoted much time and has been well supplied with funds to do a task which to him was of attractive importance. This report of the study, then, is not only noteworthy but of prime significance. The comments which follow are offered in the happy knowledge that many other workers in the field of education are pondering the meaning, significance, and effect of the Conant Report upon their schools, their tasks, and the education of their own children.

The Study

Four questions may provide a reasonable basis for judgment of the worth of the Conant study. What are the qualifications of the investigator? Is the study sound in structure? Are the conclusions supported by the data? What changes may we anticipate because of the study?

As an investigator, Dr. Conant is a remarkable combination of physical scientist, teacher, administrator, and statesman. His has been a life happily devoted to admirable intellectual attainment for the benefit of his fellow man. He is an able and attractive speaker of universal appeal, writes clearly and fluently, is disarmingly modest, and delightfully human. He is, without doubt, one of the great men of our times. Honors of a high order have been his; he knows personally most of the leaders of the free world and some of the other suasion. He has carried responsibilities of unique magnitude from Cambridge to White Sands to Bonn. It is doubt-

[1] Conant, James B. *The American High School Today:* New York: McGraw-Hill, 1959.

David B. Austin is Professor of Education, Teachers College, Columbia University, New York City.

ful that there is any other living leader of such universality of gift and accomplishment.

Yet some of us are disturbed concerning his qualification for an investigation of the American High School. Other than a background of intellectual integrity and accomplishment, how is he especially fitted for gathering and interpreting data relative to a kind of school in which he has never taught, let alone administered? For the American high school which he investigated is the public school—from which came no more than an approximate half of the Harvard students whom he taught, advised, and led. This argument need not be taken too seriously. The methods of honest inquiry do not demand saturation in the data nor long exposure. The valid question is merely this—Is Dr. Conant for any reason disqualified from acquiring and judging the facts sought? Assuming suitable vehicles of inquiry, the answer in this case is honestly, no. Dr. Conant chose to interview and observe and with the close cooperation of a staff which included long experienced workers in public high schools, we need have no fear of his qualifications.

Interestingly enough, Dr. Conant has mentioned in public his personal involvement in the study as stemming from his long prejudice favoring the American high school. When challenged by friends among the fields of higher education as to the bases for his confidence in this form of secondary education, he felt limited in his firsthand observation of the facts. Thus, he was attracted to the project which he is now completing in order to get support for his beliefs, if possible. He has referred to this process as "crystallizing his prejudices."

Further, Dr. Conant has long been interested in Education (with a large "E") and has studied higher education both here and abroad. His writings have repeatedly been admired by leaders within our profession. As a long-time member of the Educational Policies Commission, he has considered great problems of America's public schools. Further, in addition to his deep interest in education, he possesses a characteristic which enhances his qualifications as a reporter of his findings. Doors are open to him which are closed to most Americans. He is welcome at the council table of business, of industry, of legislation. When we refer to the Conant report in the singular, we are understating the very nature of the report; he has spoken to many thousands and to key individuals as well, of his study of the American high school, and will continue to do so. This, in fact, was part of the initial plan for his two-year task. Frankly, with modesty, he suggested that many people who determine policy concerning American public education would listen to him and his report.

Finally, his qualifications were supported through the interposition of the Education Testing Service of Princeton as an agency which has had experience in evaluation of things educational and which as a non-profit enterprise has a degree of prestige quite attractive to most public school people. The administration of the grant was in the hands of this agency.

Organization of the Study

So much for the qualifications of the investigator. We must next consider the structure of the study. The enormity of a task such as this requires courage, for generalizations about a group of institutions as diverse as are the secondary schools of this nation are treacherous at best. Thus, Conant carefully delimited the population to be studied and carefully titled his project "A Study of *the* American High School." Yet at best, even this is misleading, for the article "the" implies a possible identifiable institution which simply does not lend itself to actual definition in a generic sense. It is better, perhaps, then, to identify this as *a* study of *some* American high schools which seem to have certain characteristics in common. Let's list their similarities.

1. They fit to a degree Dr. Conant's definition of comprehensiveness.
2. At least half of their current students are reported as not planning for post-high school education.
3. They have been recommended to him as being "good" schools by persons whom Dr. Conant has reason to believe can judge them.
4. They are available for visitation.
5. They number among their students an intelligence span roughly equivalent to that of the total population.

It should be noted that Dr. Conant cautions the reader (p. 16) that ". . . this report is in no sense a survey of the comprehensive high school. The study has made no attempt to answer such questions as 'How satisfactory is the typical American high school?' Indeed, I am now convinced that it is impossible to obtain information on which one could generalize about the success or failure of the American high school in regard to the education of any group of children. . . . As will be made evident by this report, however, it is possible to make valid judgments about American secondary education, but only *school by school.*"

It is important to stress this point. Dr. Conant is reporting on a school-by-school study of some half-hundred institutions in twenty-six states. It is obviously not his intention to claim these as representative of American education for youth. In fact, he specifically denies this. Contrary to what has been suggested by a few and assumed, perhaps, by many, this is *not* a normative study. There is considerable danger in just this misinterpretation of the basic structure of the study.

As to the methods of study of these schools, a few sentences will suffice. In the first place, Dr. Conant made a series of assumptions which possibly were inescapable. He chose to assume, for instance, that performance "in a satisfactory manner" could be determined by interview, lists of subject offerings, enrollment data, observation of a few classes, and reports from responsible officials in answer to his written inquiries. Again, he chose to assume that a check list of criteria, as developed by himself and his staff, largely dealing with matters of school organization, was a significant and valid tool of inquiry. These and other assumptions justify a title for

the work which might be considerably less inclusive, it is argued, but they are all fundamental to the nature of the study.

Having identified the schools, Dr. Conant and his staff visited, interviewed, recorded, and observed. In each of these trips, he and at least one member of his staff interpreted their observations independently and yet consistently found substantial agreement. Applying the check list of criteria, it was possible to establish a table showing comparisons among the twenty-two focal point schools in the East, Mid-West, Southwest, and Far West. A plus was recorded where it was the judgment of the observer that such a provision as was called for on each item of the check list was evident. Thus, an inventory of certain characteristics of some schools was obtained.

As his study developed, Dr. Conant created an *academic* inventory tool which was in turn applied to the schools of the study. This, as is well known, is a check list of assessing the degree to which the academically talented enroll in courses of academic character. A third and somewhat unrelated aspect of his study dealt with the comparative achievement in physics and trigonometry of certain students in thirteen comprehensive-type high schools with their counterparts in four so-called control schools from which high percentages of students go regularly to college. This phase of the study was merely based upon the collection and comparison of specified test scores from seventeen high schools. Finally, Dr. Conant drafted a total of twenty-one items which are identified as "Recommendations for Improving Public Secondary Education."

This, then, is the basic design of the study. No doubt Dr. Conant sought counsel from a host of sources. Those who have had contact with him during the two-year period know that he asked numerous pointed and stimulating questions. He asked people to criticize his tentative conclusions, to offer suggestions as to interpretations. He prodded people into revealing their judgments or biases on the many controversial issues with which he chose to deal. Too, in his visits to schools, he revealed a most sincere interest in what teachers, students, board members, administrators, and counselors were doing and thinking.

Findings of the Study

Now let us turn to the third question, "Are the conclusions supported by the data?" Here we run head-on into both strength and a weakness. The strength lies in the tables and charts summarizing the enrollments, test scores, and judgments concerning the organizational provisions as described in the check-list items. The weakness lies in the nature of the check list itself and in the twenty-one recommendations for improving secondary education.

Most administrators and teachers will find among the recommendations many items with which they will agree readily and enthusiastically. Others of the items will be judged by experienced workers as bad, wrong, or unworkable. And all who study the report must ask the source of these

recommendations. Where are the data to support them? In introducing this section of the report, Dr. Conant writes: (p. 41) "My recommendations are based on what I have observed. Almost without exception I can point to one or more schools in which the recommended type of organization or practice can be found, not as an experiment but as something tried and tested over a period of years. Taken together, they outline the important characteristics of a satisfactory high school which is widely comprehensive, and the recommendations must be judged as a whole, for some taken separately would be almost impossible to put into effect."

"Because I have been interested in determining the characteristics of a satisfactory comprehensive high school, this section of the report may appear too conservative for the taste of many readers. Yet it follows from the premises of my study that my recommendations would include only what I had found to be well-established features of at least one school." (p. 40)

Granting that it is proof that the possibility of a given practice does exist because it is so observed, what further evidence is there to support the recommendations? From a careful reading of the report I find none except the considered judgment of Dr. Conant after he has talked with hundreds of people about these issues, proposals, and practices. There is, then, a possibility that the various recommendations imply a series of consensus reports. If so, it should be so indicated, and thus we could more carefully weigh the value of consensus in the light of the persons involved. Recommendations based upon such opinions are more convincing when we at least know the experience, biases, and responsibilities of those who hold the opinions. When Dr. Conant states that it is *his* judgment, based upon months of traveling and visits to schools in eighteen states as well as upon discussions with many, many school administrators, that three things are necessary to have a good high school and then lists these three as (1) a good board of education, (2) a good superintendent, and (3) a good principal, most readers know that the source of the judgment is basically of a logical nature. He can accept or reject the judgment as he wishes, but he has the kind of information which will help him make a decision as to its merit. On the other hand, when Dr. Conant recommends that every high-school English student should write one composition per week, that it should be read and graded by his teacher and discussed with the student, he tells us that he is convinced of this on the basis of talks with many English teachers. One wonders if the English teachers did provide him with answers as to how they would find twenty to twenty-five hours of time per week to carry out the suggestions—and one further wonders if this recommendation had been discussed with those who are responsible for determining the assignments of teachers within the high schools. Yet, without equivocation, we know the bases upon which Dr. Conant was convinced of the importance of the recommendation. If the opinions of English teachers alone were obtained, the

practical value of this important recommendation is reasonably questioned. Here, then, is an unfortunate weakness. Where is there substantial evidence to support these twenty-one recommendations? Does the existence of a practice *per se* make it good? Are the criteria which support the judgments adequate? Were balanced sources of opinions interviewed?

And now, what of the strengths? It is true that Dr. Conant has stated the limitations of the group of schools which he has considered. He supplies us with further summaries of enrollments, of his observations, judgments, and his over-all conclusions in broad and strong statements. And he cautions the reader to "avoid generalizations, recognize the necessity of diversity, get the facts about your local situation, elect a good school board, and support the efforts of the board to improve the schools." He assures the citizen to whom the report is addressed that the basic structure of American high schools is sound, does not require major overhaul. He places the study in the framework of the unique nature of American education and discusses the circumstances which force only limited degrees of comprehensiveness upon some schools. He states his judgment concerning the minimal size of a high school and supports this opinion on the basis of simple logic related to other perhaps arbitrary bases for determining goodness. And he devotes considerable attention to the academic program of the academically able. Yet along the way something is missing, and this leads to an impressive conviction that there is by necessity a great deal of "Conant" in these findings. It is interesting to speculate, for instance, on what the nature of the twenty-one recommendations would have been had Dr. Conant been a leader in the field of fine arts, or of economics, or of physical education. This is foolish speculation, of course, for Dr. Conant is not. Yet the stresses upon the fields of mathematics and science, emphases upon the importance of modern languages and the general conclusion that most academically talented youth do not work hard enough were possibly judgments of this distinguished scholar and statesman long before he embarked upon the study of the American high school. If so, one wishes that he had acknowledged the fact in this report. And such judgments as that youngsters "do not work hard enough" are certainly not of the same quality as is most of the report.

Effects of the Study

It is now time to turn to the fourth question. What changes may we anticipate because of the study? Certainly we need a crystal ball and a well-prepared dust cloth at this point. The problem of anticipating changes, however, is somewhat resolved due in part to the fact that this publication is only one phase in the total series of reports of the study. Dr. Conant's speaking calendar has proven to be rich testimony to his popularity as a speaker and to his physical as well as intellectual powers of endurance. But we would do well to examine briefly the audience to which he addresses himself most frequently.

The publication in addition to carrying the title "The American High School Today" lists a sub-title "A First Report to Interested Citizens." Dr.

Conant has been speaking to interested citizens thoughout the land. The two past annual meetings of the National School Boards Association were, no doubt, major targets in his plan. Last February, his address to this group in San Francisco coincided with the publication of his book. Further, as a founder of the National Citizens Council for Better Schools, he is obviously devoted to the proposition that our schools are largely what citizens want them to be and allow them to be. He is anxious for citizens to be interested. He speaks to them readily and gladly. His words carry weight because of his stature as an interested citizen, devoted to the public good and experienced as an educational leader.

Next, of course, Dr. Conant addresses himself directly to school administrators, knowing full well that his message will also come to them indirectly from interested citizens. He spoke of his project at the Chicago Conference on Secondary Education in October 1957. He has spoken at state and national conventions of superintendents and principals. He is not only welcome on the platform, also his reports of progress have been sought by scores of groups. That Dr. Conant is newsworthy goes without saying. Press coverage of his statements have varied in quality in harmony with coverage of any great person discussing important issues, particularly when it is felt that the speaker is qualified to discuss the issue. With few exceptions, the major periodicals have devoted much space to his recommendations, and the McGraw-Hill book achieved the best-seller list within two weeks, as reported by the New York *Times*. As we attempt to predict outcomes of the study and report, it is wise to consider several classes of action. One sees no angels treading down this guesswork path, so ventures several estimates while commenting upon several events which have already transpired.

→ 1. The interest on the part of the general public in our high schools will be further stimulated. The reassurances which Dr. Conant gives the general public that the basic structure of our program of secondary education is sound will forestall some kinds of revolutionary changes which have been proposed in some quarters. Most remarkable here is the continuing support which Dr. Conant gives to the concept of the comprehensive type of school as contrasted with specialized high schools. Neither in the press nor in professional meetings is there now as much stress upon the desirability of creating more new specialized schools as was the case, say, five years ago. This is particularly significant in the light of various speeches by the good admiral. It is possible that there will be even greater attention, on the part of the general public to the problems of academic preparation of young people of average as well as superior gift. General education will be better understood, perhaps, when placed in the context of Conant's belief as to the nature of sound general education for all. The general public will accept Conant's position regarding many of the controversial—and often unproved—issues on the organization of schools and groupings of students within these schools.

But there is also the matter of public mis-interpretation of several of

the major points of Dr. Conant's list of twenty-one recommendations. It is already known that many people who saw the two-page "spread" in *Life* magazine last spring dealing with his recommendations in a graphic form, did mis-interpret the lines and colors to the point of assuming that a rigid "tracking" of students through the high school was urged. Those who have heard Dr. Conant speak on this matter, or who bothered to read the accompanying material in *Life*, know that such is not the case. In other words, superficial attention and conclusion-jumping can provoke much more harm than good—particularly if the report of the study is "swallowed" without benefit of mastication.

→ 2. It is in the area of board activities and administrator-board relationships where we may expect some of the most positive and productive influence of the report to be manifest. It is in the support of the academic program for the academically superior without due concern for program balance that we may find some of the most destructive effect of the report.

Already we know of many cases where boards are instructing the superintendent to draw up a report of the "academic inventory" which Dr. Conant has developed. But the critical question is not the worth of the inventory—most agree that it is an excellent idea—but rather, what is to be done with the findings? There may be some serious dislocations within many communities across the land if unthinking steps are taken to force the "academic inventory" of the upper group of students into a mold. When Dr. Conant recommends that third- or fourth-year modern language be taught "no matter how few students enroll," he is establishing a position from which there is little chance for retreat. Assuming a given number of teachers, a given budget for salaries, a given number of students to be taught—what is to give way in order to insure that advanced class in French? This is no new problem to administrators, of course, but for the first time, some boards of education are going to be called upon to cancel band, or basketball, or Latin, or remedial reading. It is a matter of relative values in one sense, and in another it goes back to the simple question of equality of educational opportunity. Does the local board member feel that it is better to deny the handicapped reader a chance to improve his skills in order that a student of academic gift may have a fourth year of French? In fact, does Dr. Conant believe this? Obviously he does not. But a basis for an order of priority for each school and school system must be established.

→ 3. In the midst of the fog which may surround many conscientious superintendents and principals as they attempt to analyze critically the significance of the report for their school, we will find certain little bright lights which may point some directions. Some of us will take advantage of these in our search for orientation. Others will ignore them and go confidently forward in the belief that they know where they go and why. Here are a few of the lights worthy of navigational consideration:

a. On page 40, in concluding that most able boys take math and science to the detriment of the program in foreign languages and that the able

girls too often avoid all three, Dr. Conant again reminds the reader that "a correction of this situation in many instances will depend upon an altered attitude of the community quite as much as upon action by a school board or the school administration."

b. "It would be most unfortunate if the conservative recommendations in this section, necessarily presented in rather dogmatic form, should lead anyone to believe I was in favor of freezing the development of the curriculum or the organization of a high school." (p. 42) This statement precedes the listing of twenty-one recommendations for improving secondary education.

c. (p. 96) "As I have already stated, I am convinced American secondary education can be made satisfactory without any radical changes in the basic pattern. This can only be done, however, if the citizens in many localities display sufficient interest in their schools and are willing to support them. The improvements must come school by school and be made with due regard for the nature of the community. Therefore, I conclude by addressing this final word to citizens who are concerned with public education: avoid generalizations, recognize the necessity of diversity, get the facts about your local situation, elect a good school board, and support the efforts of the board to improve the schools." This would urge critical, considered judgment as a prior step to program changes—even those changes which may be recommended by Dr. Conant himself.

For those who choose the independent act without benefit of the bright lights along the path, the unquestioning acceptance of the recommendations of this report, (or their complete rejection) may be the obvious direction. We have already seen brightly colored brochures from certain schools which purport to convince the local citizen of the similarity between the Conant recommendations and current (often long-established) practices in the local school. This is most unfortunate. Far better to use the Conant report as a study guide for interested staff members and citizens as they consider its pertinence to the local situation, and the desirability and means of changing the local organization and procedure. To those who choose to weigh the recommendations carefully, there is a world of richness which can be the very heart of a school-improvement program if used wisely and not blindly. Starting with a series of items on the check list to assist in evaluating a comprehensive high school (p. 24), and referring to Appendix C for elaboration on the points listed (p. 102), a critical and stimulating review of beliefs, prejudices, and research results can be completed which would not only serve better to help all participants understand the problems and challenges of organization for the school, but would logically lead to study in depth of the relatively superficial criteria listed, as well. There would not be much danger that such an inquiry would lead to confusion of even the most naive nonprofessional. There is a potential here as well for meaningful, stimulating study to satisfy the most profound pedagogue. And the encouragement to explore published and available research concerning many of the prob-

lems listed and judged by Dr. Conant and his staff is one of the great strengths of the work.

Here, then, is the real meaning of this work for administrators. An appraisal of the recommendations of a devoted investigator by experienced and involved workers in the field of education will not only lead to better soul-searching on the part of the administrator and teacher, but will likewise contribute to improvement of the schools if the administrator and staff will but use the study critically and rationally.

→ 4. Finally, and in fact, most important is the challenge to good teaching which is presented by this book. Dr. Conant throughout the work implies a faith in the quality of teaching which astounds some and encourages others. To indicate that the excellence of a school can be judged by listing course offerings reveals an almost unreasoning faith that if offered, the knowledge and skills and ideas will be learned. On page 45, there appears this statement: "I should like to emphasize at this point the importance of recognizing fully the role of adequate motivation in determining the eventual success of any student." No other stress on the heart, soul, and body of the educational process is to be found in this work. The assumption that homework is important, and will be made to contribute to the effectiveness of the learning of young people, and will serve as a basis of definition of things academic is so remarkable that it leaves the writer a bit breathless. For as a teacher, he has been guilty of using homework as a means of punishment, as a means of convincing parents of the seriousness of their children's teacher, as a means of teaching youngsters that, if they are identified as "bright," they will have more tedious stuff to do when they get home than their normal classmates will. And this in the days before the one-eyed monster took over the corner of the living room in most homes!

Today's high-school teachers no doubt are better qualified to use homework more effectively. Dr. Conant certainly encourages them in this worthy practice. In using *The American High School Today*, administrators and all interested citizens will need to be rational and critical in the same spirit as that which we seek to instill in all students. Blind acceptance of published statements is neither good citizenship nor good scholarship. The administrator's role in leading all groups to a careful appreciation of the strengths and weaknesses of the Conant report as they have pertinence for each individual school and school system is clear. If this role is faithfully filled, if the honest responsibilities of leadership are discharged, American high schools will not only be good today, but also much better tomorrow.

Further, it is to be hoped that Dr. Conant's continuing study of other aspects of public education in the United States will provide even greater opportunities for the American public as a whole to sense the urgency of need for understanding the complex business of educating young people for today and for the future. Certainly our schools have no greater champion in modern times than this distinguished gentleman and scholar.

Best Books of 1958 on Vocational Guidance

ROBERT HOPPOCK

EACH year the author of this article undertakes to review all new books on vocational guidance, except those devoted primarily to occupational information, which are reviewed in the *Career Index* and in the *Occupational Index*. The best of the books dealing with the theory and practice of vocational guidance are annotated in an annual list; this is it. Included are some earlier references which did not reach us in time to be included in the 1957 list.

Inclusion of a book in this list does not mean that it is considered infallible. It does mean that the book has been compared with other publications and considered to contain useful information that would be of interest to readers who try to keep up to date on the better literature in this field. Apologies are made in advance to authors and publishers whose books have not been included and to those who find the annotations inadequate.

Andrew, Dean C., and Willey, Roy De Verl. *Administration and Organization of the Guidance Program*. New York: Harper and Bros. 1958. 330 pages. $4.50. Principles of administration and organization. The administrator's responsibilities. Initiating guidance services. Selection, assignment, and coordination of personnel. Administration of individual inventory, educational and occupational information, counseling, group, placement, and evaluation services. Interpreting guidance functions.

Baer, Max F., and Roeber, Edward C. *Occupational Information*, second edition. Chicago: Science Research Associates. 1958. 495 pages. $5.95. Kinds and sources of occupational information. Appraising occupational literature. Follow-up and community surveys. Occupational information service. Career planning and development. Using occupational information with groups and in counseling.

Barr, John A. *The Elementary Teacher and Guidance*. New York: Henry Holt and Co. 1958. 435 pages. $4.50. "To help the teacher gain an understanding of the guidance process." Mental hygiene. Family effect on children. Behavior, misbehavior, and discipline. Tests, scattergrams, sociometrics. How children tell about themselves. Home-school relations. Studying children. Gifted. Handicapped. Special services and agencies. Organizing guidance in the elementary school.

Bowles, Frank H. *How To Get Into College*. New York: E. P. Dutton and Co. 1958. 157 pages. $2.95. *Who Goes and Why*. Preparing for, choosing, financing, and staying in college. Application and admission. Tests and

Robert Hoppock is Professor of Education in the School of Education, New York University, New York, New York.

testing. College and the armed services. For high-school students and their parents. Readably presented in 358 questions and answers.

Caplow, Theodore, and McGee, Reece J. *The Academic Marketplace.* New York: Basic Books. 1958. 262 pages. $4.95. How vacancies occur and how they are filled in the liberal arts departments of major universities. A report on interviews with professors and administrative officers. Some surprising revelations.

Cohen, Nathan M. *Vocational Training Directory of the United States,* third edition. Arlington 1, Va.: Potomac Press. 1958. 228 pages. $2.95. Courses, entrance requirements, tuition and approval status of 7,303 private and public semi-professional, technical, and trade schools.

Deane, Calvin J., and others. *Introduction to College.* Boston: Allyn and Bacon, 1958. 168 pages. $2.95. Textbook for a freshman orientation course. The new student looks at college; studying effectively; personal and social adjustment; planning your career; philosophy of life. Assignments, review questions, bibliography.

Directory of Accredited Institutions and Operating Criteria. Washington 5, D.C.,: 1958-59. 28 pages. Free. Based upon reports of evaluating teams that have examined the schools. The Commission is sponsored by, but its decisions are not subject to review by, the National Association and Council of Business Schools.

Directory of Business Schools in the United States. Washington 9, D.C.: National Association and Council of Business Schools. 1958. 19 pages. Free. Schools that have met membership requirements of the Association. Student capacity. Courses offered.

Directory of Vocational Counseling Services. 1958-1960. American Board on Professional Standards in Vocational Counseling, Inc. Distributed by American Personnel and Guidance Association, Washington 5, D.C. 1958-1960. 101 pages. $1.50. Criteria for approval of agencies. List of approved agencies with addresses, office hours, fees, *etc.* Arranged by states, plus Canada and Puerto Rico.

Dubin, Robert. *The World of Work.* Industrial Society and Human Relations. Englewood Cliffs, N.J.: Prentice-Hall. 1958. 448 pages. $7.95. Industrial sociology. Human relations. Structures of organizations, behavior systems, jobs, positions, offices. Group life of organizations. Institutional bases of decisions. Labor force and backgrounds. Technology, production, automation, and human relations. Motivation and morale. Incentives. The individual worker. Mobility. Grievances, communication, rules and enforcement. Management as a bureaucracy and as leadership.

Feder, Daniel D., and others. *The Administration of Student Personnel Programs in American Colleges and Universities.* Washington, D.C.: American Council on Education. 1958. 46 pages. $1.00. Admissions, registration, and records. Counseling, health, housing, food, student activities, financial aid, placement, and discipline. Special clinics and services. Administrative objectives, functions, plans, forms, and problems. Selection, placement, and development of staff. Evaluation.

Fine, Benjamin. *How To Be Accepted by the College of Your Choice.* Great Neck, N.Y.: Channel Press. 1957. 134 pages. Paper $1.95; cloth $3.95. College acceptance statistics. What the Ivy League looks for. Significance of grades. College entrance examinations. Sample questions and answers. Course requirements. Extracurricular activities. Letters from alumni and how the

colleges regard them. Your autobiography. Visiting colleges. Quota systems. How to file your application. Ways of defraying the costs. Transfers. Junior colleges. Public *vs.* private schools. Brief data on 967 institutions: location, courses, enrollment, admissions criteria, costs.

Forrester, Gertrude. *Occupational Literature*. New York: H. W. Wilson Co. 1958. 603 pages. $6.50. Revision of a standard reference. Best of its kind. Contains 4400 references, of which 2800 are new, 1,000 are free. For teachers, counselors, and librarians who help readers to choose careers. Belongs in every school library.

Froehlich, Clifford P. *Guidance Services in Schools*. New York: McGraw-Hill Book Co. 1958. 383 pages. $5.75. Revision of *Guidance Services in Smaller Schools*. New illustrative material. New chapter on elementary schools. Other chapters on basic services, organization, orientation, group methods, information service, studying the individual, counseling, placement, teachers and guidance, curriculum, public relations, and research.

Froehlich, Clifford P. *Teacher's Manual To Accompany Guidance Services in Schools*, second edition. New York: McGraw-Hill Book Co. 1958. 54 pages. Free. For each chapter: purposes, supplementary topics, activities, audio-visual aids, examination questions.

Gates, James E., and Miller, Harold. *Personal Adjustment to Business*. Englewood Cliffs, N.J.: Prentice-Hall. 1958. 488 pages. $5.95. Importance of career placement. Selecting the occupation and the employer. How will the employer appraise you? How do you look? Ways to get a job. Letters of application, follow-up, acceptance. The personal interview. First six months on the job. How to prevent failures. Making promotional possibilities. Problems of supervision. Job insurance. Going into business for yourself.

Glanz, Edward C., and Walston, Ernest B. *An Introduction to Personal Adjustment*. Boston: Allyn and Bacon. 1958. 348 pages. $5.75. A textbook for an introductory course in psychology for college students. Designed to increase self-understanding, to facilitate planning, and to provide a background for counseling. Psychology, college, and life. Motivation and values. Learning, behavior, personality, maturity, individual differences. Vocational interest, aptitudes, intelligence. Self-analysis, planning, occupational information.

Guide To Preparing a Resume. New York: New York State Employment Service. No date. 37 pages. Free. Limited supply. For the professional and managerial applicant. Preliminary analysis of facts. Planning. Suggested outline. Covering letters. Sample resumes and letters. Bibliography.

Hadley, John M. *Clinical and Counseling Psychology*. New York: Alfred A. Knopf. 1958. 682 pages. $8.95. Text edition $6.75. One chapter of 21 pages on vocational guidance and counseling covers significance, definition, factors to consider, occupational information, and use of tests.

Hatch, Raymond N., and Stefflre, Buford. *Administration of Guidance Services*. Englewood Cliffs, N.J.: Prentice-Hall. 1958. 499 pages. $6.50. Theory and practice of administration. Pupil personnel services. Organizational patterns and personnel. Administrative problems of the guidance services. Budget and facilities. Evaluation. Improving the guidance services. Case studies of three school districts. A guide to the use of case studies. A guidance checklist for high-school students. A checklist for the high-school program. A checklist of guidance services for elementary schools.

Herzberg, Frederick; Mausner, Bernard; Peterson, Richard O.; and Capwell, Dora F. *Job Attitudes: Review of Research and Opinion.* Pittsburgh, Pa.: Psychological Service of Pittsburgh. 1957. 279 pages. $7.50. A comprehensive, critical review of the literature on the prevalence of job dissatisfaction, characteristics of dissatisfied workers, factors related to job attitudes, effects of job attitudes, social aspects of the job, supervision and job attitudes, vocational selection and job attitudes, and mental health in industry.

Hill, Alfred T. *A Directory of Small Colleges.* Washington 6, D.C.: Council for the Advancement of Small Colleges. No date. 37 pages. 50¢. Admissions, facilities, size, cost, financial aid, location, control, and academic program of 64 small colleges in 31 states. Average size 300. Average annual cost of tuition, board, and room $850. Many can accept more students.

How To Get Into College and Stay There. Chicago 10: Science Research Associates. 1958. 121 pages. $1.95. *Counselor's and Teacher's Manual* by Harold L. Munson. 17 pages. Free with 10 copies of book. Otherwise 50¢. Should you go? Your high-school program. Achievement and skills. Making your choice. How to apply. Costs. What is college like? Selective service and your plans.

Hutson, Percival W. *The Guidance Function in Education.* New York: Appleton-Century-Crofts. 1958. 680 pages. $6.00. An introductory book for "all school workers." History and definition. Social scene. Educational scene. Need. Components. School publications. School organization. Curricular and extracurricular experience. Study of occupations. Homeroom and alternative organizations. Analysis of the individual. Synthesis, diagnosis, and prognosis. Counseling and treatment. Placement, follow-up, organization, administration, and evaluation.

(The) Identification and Education of the Academically Talented Student in the American Secondary School. Washington 6, D.C.: National Education Association. 1958. 160 pages. $1.50. Report of a conference. Cultural attitudes, goals, program considerations, curriculum considerations, and essential professional concerns. Curriculum considerations limited to English, mathematics, modern languages, science, and social studies.

Job Guide for Young Workers. Washington 25, D.C.: Superintendent of Documents. 1958-59. 66 pages. 40¢. Brief descriptions of approximately 100 typical entry jobs. Duties, characteristics, qualifications, employment prospects, advancement, and location. Introductory sections on how to get a job, job outlook, other publications, *etc.* Should be available to every high-school student who will soon look for a job.

Kahn, Robert L., and Cannell, Charles F. *The Dynamics of Interviewing.* New York: John Wiley and Sons. 1957. 368 pages. $7.75. Theory and techniques of the information-getting interview. Transcripts and comments.

Karl, S. Donald, and Diehl, Barbara L., editors. *The College Handbook.* Princeton, N.J.: College Entrance Examination Board, Box 592. 1957. 412 pages. $1.50. Choosing a college. Financial aid. Colleges participating in College Scholarship Service. Enrollment in member colleges. Advanced placement. Test use and application dates of member colleges. Self-descriptions of 184 member colleges including location, size, admission, programs of study, freshman year and cost.

Lovejoy, Clarence E. *Lovejoy's Prep School Guide.* New York: Harper and Bros. 1958. 120 pages. $4.50. Characteristics of independent schools.

Admission. Scholarships. Church related schools. Special schools for the blind, deaf, *etc.* Brief descriptions of 1800 non-public secondary schools. Considerable information on some; very little on others.

Lovejoy, Clarence E., and Jones, Theodore S. *College Scholarship Guide.* New York: Simon and Schuster. 1957. 123 pages. Paper $1.95; cloth $3.95. Directory of financial aids to undergraduate and graduate students. Indexed by college, donor, and field of study. Related information on the College Scholarship Service and the Scholarship Qualifying Test.

Martinson, Ruth, and Smallenburg, Harry. *Guidance in Elementary Schools.* Englewood Cliffs, N.J.: Prentice-Hall. 1958. 322 pages. $4.95. Definition. Development. Cost. Materials. Methods. Group study. Testing. Records. Need, qualifications, duties, roles, and relationships of personnel. Exceptional children. In-service study. Parents. Evaluation. Orientation to secondary school.

McKinney, Fred. *Counseling for Personal Adjustment.* Boston: Houghton Mifflin Co. 1958. 584 pages. $6.00. Goals, needs, drives, anxiety, problems, adjustment, diagnosis, referral, consultation, cases, traits, roles, clients, relationships, tension, resistance, release, insight, plans, action, techniques, services, counselors, functions, training, ethics, treatment, cases, tests, occupational information, school activities, group work, courses, parents, discipline, evaluation. The counselor's personal development.

1958 Handbook of Women Workers. Bulletin 266. U.S. Department of Labor. Washington 25, D.C.: Superintendent of Documents. 1958. 153 pages. 45¢. Numbers, occupations, ages, family status, income, education. Labor laws, political and civil status. Organizations.

Occupational Information for Counselors: An Annotated Bibliography, revised. Washington 25, D.C.: Superintendent of Documents. 1958. 24 pages. 15¢. Publications of the U. S. Department of Labor on occupational and industrial information, manpower, counseling, career planning, older workers, apprenticeship, child labor, wages, hours, and benefits. Periodicals and other publications.

Patterson, C. H. *Counseling the Emotionally Disturbed.* New York: Harper and Bros. 1958. 458 pages. $6.00. Nature and extent of emotional disturbance. Rehabilitation services. Qualifications, preparation and training of the counselor. Selection of clients. Counseling. Tests. Selecting a vocational objective. Occupational adjustment. Placement, training, and follow-up. Sheltered workshops. The future and its needs.

Robinson, H. Alan. *You and Your Career.* New York 19: Collier's Encyclopedia. 1958. 24 pages. 25¢. Brief information on 100 occupations in a 16-page chart. Related discussion of choosing an occupation and planning an education. Sources of occupational information; checklist of questions to ask about any occupation. Publishers of occupational pamphlets. Reprinted from *Collier's Encyclopedia Year Book 1958.*

Rosenberg, Morris. *Occupations and Values.* Glencoe, Ill.: Free Press. 1957. 158 pages. $4. A study of several thousand college students in eleven universities. Criteria for career choice, faith in people and occupational attitudes, personality and career, social determinants of occupational choices and values, systems of occupational circulation, change in individual choices, ends and means of occupational action, reluctance, and resolution.

Rothney, John W. M., and others. *Guidance Practices and Results.* New York: Harper and Bros. 1958. 542 pages. $6.00. An eight-year study of 347 high-school students who were given special counseling and compared with a similar group who did not have such special attention. The experimental group made more progress in employment during the five years following high-school graduation. This difference was statistically significant. Most differences "were less than one would hypothesize."

Sechrest, Carolyn A. *New Dimensions in Counseling Students: A Case Approach.* New York: Bureau of Publications, Teachers College, Columbia University, 1958. 119 pages. $3.00. Excerpts from counseling interviews, with comments and questions about them. Defining and establishing a counseling relationship. Counseling, discipline, and teachers. Using school consultants. Locating the real problems. Preparing for referral. Maintaining a long-term relationship.

Segel, David; Wellman, Frank E.; and Hamilton, Allen T. *An Approach to Individual Analysis in Educational and Vocational Guidance.* Washington 25, D.C.: Superintendent of Documents. 1958. 39 pages. 20¢. Intellect, specific aptitude, and other measures in educational and vocational guidance.

Stoops, Emory, and Wahlquist, Gunnar L. *Principles and Practices in Guidance.* New York: McGraw-Hill Book Co. 1958. $5.50. 369 pages. Information about the individual, and about educational, personal, and vocational opportunities. Counseling. Placement. Follow-up. Essentials of a good guidance program. Personnel. Budget. Public relations. Circulating guidance information. Evaluation.

Thomas, Lawrence. *The Occupational Structure and Education.* Englewood Cliffs, N.J.: Prentice-Hall. 1956. 502 pages. $6.25. The significance of pre-job preparation from the social viewpoint of achieving a more equitable distribution of the nation's labor force. Determinants of income. Prestige, job satisfaction, ambition, competence, intelligence, ability, personality, schooling, experience. Sociology of the occupational structure. Democratic values and occupational problems. Vocational functions of the schools.

Wilson, Eugene S., and Bucher, Charles A. *College Ahead! A Guide for High School Students—and Their Parents.* New York: Harcourt, Brace and Co., 1958. 168 pages. $3.95. Abilities, interest, preparation, finances. How colleges differ. How to apply. The first year. Excellent chapter on how to visit a college, with eight pages of questions to ask.

World-Wide Graduate Award Directory. Brooklyn 22: Advancement and Placement Institute. 1957. 28 pages. $2. Awards made by 350 universities and foundations in 45 states and 30 countries.

World-Wide Summer Placement Directory. Brooklyn 22: Advancement and Placement Institute. 1958. 26 pages. $2. Jobs open to high-school and college students and teachers, and others, in government, steamship companies, dude ranches, travel agencies, camps, parks, theaters, service projects, industrial trainee programs.

Your Life Plans and the Armed Forces. Washington 6, D.C.: National Association of Secondary-School Principals. 1958. 160 pages. $1.25. This is a unit of study to help high-school youth fit service in the Armed Forces into their educational and vocational plans. A complete description of educational opportunities in the services will be found in this book. Up-to-date information about youth's military service obligations and options are presented.

The Book Column

Professional Books

AHMANN, J. S., and M. D. GLOCK. *Evaluating Pupil Growth.* Boston 11: Allyn and Bacon, Inc., 150 Tremont Street. 1959. 619 pp. $6.50. Each of the book's four parts contributes to one or more of the six goals and indirectly to several others. In many instances these relationships are self-evident. In Part One, "Evaluation in Education," the role of evaluation in education is defined, the use of educational objectives as a basis of evaluating is established, and a number of evaluation procedures are introduced. Part Two, "The Characteristics of a Good Evaluation Instrument," is devoted to validity, reliability, and means of reporting the degree of pupil achievement that exists. Part Three, "Informal Methods of Evaluating Achievement," contains discussions of teacher-built objective and essay tests, methods by which such tests can be evaluated, and teacher-built instruments for evaluating pupil performance. In Part Four, "Evaluating Pupil Behavior and Improving Learning," standardized achievement tests, aptitude tests, and inventories for evaluating personal-social adjustment are described, the use of evaluation data in diagnosis and remediation is explained, and methods of determining and reporting pupil growth are discussed.

ASSOCIATION FOR SUPERVISION AND CURRICULUM DEVELOPMENT. *Learning and the Teacher.* Washington 6, D. C.: The National Education Association, 1201 16th Street, N. W. 1959. 232 pp. $3.75. Hundreds of scientific studies on learning and related topics have been conducted and findings reported during the past fifty or more years. As a result, much potentially useful information about the learning process is available. It is encouraging to know that many of the most effective teaching and curriculum practices throughout the country have come about as a result of thoughtful examinations of research findings on learning and related topics, and through continuous evaluation of outcomes of the educative process.

But even with an accumulation of scientific information on learning available, leaders in the field are cognizant of the fact that many important teaching-learning tasks are not easy to perform. Lack of widespread knowledge about the findings and limited understanding of what they mean in relation to teaching and curriculum tasks are among the factors that tend to retard improvement in practice. As two of the authors of this book say, ". . . much of educational psychology, especially if 'learned' for examinations before experience in the classroom, does not readily function in the teacher's daily life."

From a number of different points of view, the authors of this book describe and interpret what they see in the classroom setting itself of better ways of helping children learn. This book should be a useful source for teachers and other curriculum workers who want to increase their knowledge and understanding of the teaching-learning process.

BARCLAY, DOROTHY. *Understanding the City Child: A Book for Parents.* New York 22: Franklin Watts, Inc., 575 Lexington Avenue. 1959. 287 pp. $4.95. In this book the author shows how to take advantage of the city's special opportunities, and how to deal with special problems of city living.

The author says, "The city child of city parents, attuned to and happy in patterns of city living, can have as rich and full a childhood as his counterpart in suburb or country. His childhood will be different, certainly, but it need not be less satisfying. "To assure this within a complicated city structure, however, his parents may need to be more conscientiously aware of his needs, alive to the city's opportunities, and alert to its dangers."

BENNETT, G. K.; H. G. SEASHORE; and A. G. WESMAN. *Manual for the Differential Aptitude Tests.* New York: The Psychological Corp., 304 East 45th Street. 1959. 96 pp. This is a third revision of the book. This current revision of the DAT manual has been undertaken because of three developments: (1) additional significant research which should be incorporated; (2) the availability of a combined booklet edition of the tests to complement the separate booklet edition; and (3) the development of norms for the combination of Verbal Reasoning and Numerical Ability scores, to serve as a measure of scholastic aptitude in situations where a single score is particularly desirable. The format of the manual has been changed slightly to accommodate the new materials embodied in this revision and to permit greater flexibility with respect to adding supplements to future paintings.

BEREDAY, G. Z. F., and LUIGI VOLPICELLI, editors. *Public Education in America.* New York 16: Harper and Brothers, 49 E. 33rd Street. 1958. 224 pp. $4. This volume sets the record straight as to the purposes and achievements of American public education. Here seventeen recognized leaders of educational thought and practice give a comprehensive and objective appraisal of how our system functions in its variety of institutions from elementary school through college. Topical chapters deal with such subjects as religion in the schools, the race problems, Federal control, international understanding, and others. The resulting volume is not a specialist's book. Taxpayers and parents will find both interest and profit in this account of American education in action.

BOND, H. M. *The Search for Talent.* Cambridge, Massachusetts: Harvard University Press. 1959. 67 pp. $1.50. The Inglis Lecture in Secondary Education. The author contends that "wherever and whenever standardized tests are applied, the scores range themselves according to the wealth or poverty of the populations concerned." He also states, "At the least, we can even now predict where the 'incentive' scholarships, proposed to be provided by Federal funds, will go, by social class, by occupational origin of family, and by race." He asks, "Who will win these 20,000 scholarships?" He states, "Of these 9,034 will be the children of professional and technical workers; 616 will be the children of farmers and farm managers and farm laborers; 4,442 will be the children of managers, officials, and proprietors; 1,082 will be the children of clerical and kindred workers; 2,162 will be the children of craftsmen and foremen; 1,038 will be the children of operatives and kindred workers. None will be the children of private house workers; 274 will be the children of Service workers; 38 will be the children of (3,581,000) laborers; and 38 will be the children of (6,390) librarians." He further states: "Our American dilemma now is, that with an avowed ideal of equal opportunity and imagined free mobility from class to class, we have never, in this country, applied to ancient class structures the full potential force of the school, the only instrument capable of effecting such drastic social change. We have supported this instrument with scarcely more funds than we spend, annually, on liquor, tobacco, and other drugs and narcotics. We have allowed residential, economic, and racial segre-

gation to reconstruct and reinforce social class strata. We have grudgingly given teachers, on all levels of instruction, a standard of living too low to attract or hold the personnel worthy of the magnitude of the task. In depressed regions, and with underprivileged social and racial classes, the school has been the feeblest instrument imaginable for performing either selective, distributive, or even educational functions."

BORTNER, D. M. *Public Relations for Teachers.* New York 7: Simmons-Boardman Publishing Corp., 30 Church Street. 1959. 180 pp. It is the purpose of this book to help the teacher understand his unique responsibilities and opportunities in school public relations and, further, to suggest to him some principles and specific techniques which can help him fulfill them. Because he operates within the framework and limitations established by his principal, attention is given, in a final chapter, to the public relations role of this official.

The book does not pretend to be a comprehensive treatment of school public relations, nor does it make any attempt to suggest ways to organize and conduct a total school public relations program. This book is directed to the teacher and, to a lesser degree, the principal of the individual school. It has purposely been kept short with a view to specificity and conciseness in the hope that it will be useful to the busy in-service teacher as well as the teacher trainee.

BRACKENBURY, R. L. *Getting Down to Cases.* New York 16: G. P. Putnam's Sons, 210 Madison Avenue. 1959. 222 pp. $4. Instead of describing various philosophical viewpoints and deducing educational implications therefrom, the author introduces into his chapters specific problematic situations. Each situation is developed to represent one or more of the crucial issues in education today. After they are described, the basic issues are clearly identified. Alternate philosophical solutions are then offered and the assumptions underlying these solutions are discussed and evaluated.

CHIEF STATE SCHOOL OFFICER'S STUDY COMMISSION. *Responsibilities of State Departments of Education and Health for School Health Services.* Washington 6, D. C.: Chief State School Officers, 1201 Sixteenth Street, N. W. 1959. 56 pp. 35¢ per single copy; 25¢ for 10-99 copies; 20¢ for 100 or more copies, postpaid. This brochure was jointly sponsored by this Council and the Association of State and Territorial Health Officers in 1951. The revised edition includes a considerable amount of new material and a list of current references. This bulletin defines suitable programs of school health services and describes how state and local education and health agencies may work together to achieve them.

———. *Responsibilities of State Departments of Education for Instruction.* Washington 6, D. C.: Chief State School Officers, 1201 Sixteenth Street, N. W. 1959. 20 pp. 25¢ per single copy; 20¢ for 10-99 copies; 15¢ for 100 or more copies, postpaid. A brief policy bulletin which identifies major responsibilities of the state education agencies in planning, establishing, and improving instructional programs.

CRUICKSHAND, W. M., and G. O. JOHNSON, editors. *Education of Exceptional Children and Youth.* Englewood Cliffs, New Jersey: Prentice-Hall, Inc. 1958. 737 pp. Eleven nationally known educators, all major authorities in their field, have contributed to this volume. These specialists have provided a program which will interest anyone concerned with the mental, physical, and emotional development of exceptional children. A definitive and penetrating study, the book describes modern practices and scientific techniques in the education of children with various kinds of exceptionality. It traces the

historical development of this type of special education, includes a critique of various kinds of programs, and examines in detail all philosophical considerations. The place of the residential school, the special community school, and the special class are also considered. This study includes adolescents as well as elementary-school children, and gives full attention to the matter of guidance for exceptional children as well as the administration of special education.

EDDY, JR., E. D. *The College Influence on Student Character.* Washington 6, D. C.: American Council on Education, 1785 Massachusetts Avenue, N. W. 1959. 198 pp. $3. Today's colleges and universities are asked to produce men and women with trained intelligence as well as the strength of character that will enable them to assume especially heavy responsibilities. Can this enormous task be accomplished in four years?

This report on how the college influences student character is the result of an on-the-spot study of twenty campuses in seventeen states throughout the country. In the words of Dr. Dana L. Farnsworth of Harvard University, it is "an eloquent and persuasive call for attention to those factors which encourage the development of excellence, both in character and intellectual power." Included are chapters on the level of expectancy, teaching, the curriculum, student responsibility, religious understanding, the campus environment, and the selection of goals.

Education in a Free Society. Pittsburgh 13: University of Pittsburgh Press. 1958. 59 pp. $3. This volume marks the beginning of a new series of the Pitcairn-Crabbe Foundation Lectures at the University of Pittsburgh. It is composed of three parts: "The Impacts of Science on a Free Society" by Reuben G. Gustavson; "Inwardness: The Dimension Behind the Forehead" by Peter Viereck; and "The Prospect for Higher Education" by Paul Woodring.

Education in Pennsylvania—Today and Tommorrow. Harrisburg: Pennsylvania State Education Association, 400 North Third Street. 1958. (Dec.). 123 pp. This is the report of a committee of fifteen chosen to study the status of education in Pennsylvania with the view to presenting recommendations for a comprehensive program to meet the needs of the future. In this report, the committee discusses many areas of the state's school program, indicates current crucial problem and needs, and makes recommendations for improvement.

Educational Administration in a Changing Community. Washington 6, D. C.: American Association of School Administrators. 1959. 221 pp. $5. The book shows vision in the first chapter when the many issues, made more complex by an ever-expanding community, are identified. The vision is broadened when the next two chapters portray the whole social matrix of the community and its relationship to education. In fact, the second and third chapters treat the sociology of community life and form the base on which the whole book rests. The remainder of the book portrays the superintendent of schools as a man who must have unusual understanding and comprehensive educational preparation if he is to wear the many coats suggested by his job as community educational leader.

The commission membership was as diversified in philosophy and educational background as the communities and school systems in which the superintendents of America must work. The members, therefore, found difficulty, as well as intellectual stimulation, as they tried to resolve personal differences on what constitutes the total educational program of a community, the segment which is the responsibility of the public school, and just where the superintendent's role begins and ends. This yearbook, therefore, represents many compromises,

developed through the difficult and sometimes frustrating process of discussion and reluctant consensus. Although most of the final content represents agreement, the individual members cannot be held responsible for all points of view expressed.

Whether the school administrator serves as superintendent, principal, or in some other capacity, he will find many practical suggestions throughout the book. His philosophical concepts will be challenged. For school-board members, the information contained in this yearbook should bring enlightenment and perhaps amazement over the complex responsibilities carried by the man they selected to administer their schools.

ELBERS, G. W., and PAUL DUNCAN, editors. *The Scientific Revolution.* Washington, D. C.: Public Affairs Press, 419 New Jersey Avenue, S. E. 1959. 288 pp. $6. This book, the editors point out in the preface, grew out of a recognition that the American people must choose between surrendering unconditionally to the challenges of the age of science into which we are now swiftly moving or making a total commitment to meeting the crisis with all the resources at our command.

This work is divided into seven sections. It opens with a discussion of the scientific revolution and its implications for this nation's future, moves to an appraisal of the problems we face in developing a science program adequate to the nation's needs, and then to an assessment of the role of science in society and of the effect a lack of public understanding is having upon science and the scientist. The concluding sections examine the adequacy of our educational system in providing the human resources to meet the challenge of the scientific revolution.

GARRISON, R. H. *The Adventure of Learning in College.* New York 16: Harper and Brothers, 49 East 33rd Street. 1959. 270 pp. $3.25. This book is "a kind of staged, abstract biography of the student growing to learning—or learning to grow, in college." Following the steps from intellectual chaos to order, from confusion to focus, it dramatizes and interprets the actual process of undergraduate learning, while challenging the student to use his growing capacities. Generalizations about education are illustrated with anecdotes and descriptions of college experience in such a way as to help the student-reader identify with the situation in terms of his own problems. The book is written in clear, direct prose that is refreshingly free of cumbersome language.

GOOD, C. V. *Introduction to Educational Research.* New York 1: Appleton-Century-Crofts, Inc., 35 W. 32nd Street. 1959. 438 pp. This is an introductory book on research methods for field workers, graduate students in the early stages of their work, and seniors in the undergraduate college. It is intended to serve the purposes of both producers and consumers of research, with research presented as a method of problem-solving or of finding answers to significant hypotheses or questions.

The series of chapters follows the sequence or steps of reflective thinking or problem-solving, although it is recognized that there is frequently a shuttle-like movement from hypothesis to data to tentative conclusions and often back to formulation and testing of a new hypothesis until the correct answer or interpretation is found. These steps in research and in development of a graduate thesis or project include formulation of the problem, together with a survey of the pertinent literature; selection and use of an appropriate data-gathering procedure, including analysis and interpretation of the evidence; and preparation of the research or technical report. In this book, analysis and interpretation

of data are presented in the functional setting of the chapters on research methods rather than as separate discussions.

By delimitation of scope, this text has left to the many specialized graduate courses and books the quantitative details of testing and statistics (except as mentioned briefly from time to time for illustrative purposes): intelligence tests and measures of general mental ability, measurement and prediction of special abilities or aptitudes, personality and character tests, measures of attitudes and interests, projective methods and other devices for the study of personality, psychometric and sociometric techniques with emphasis on standardized testing and statistics, and educational or accomplishment tests in schools and elsewhere.

GREENE, H. A., and W. T. PETTY. *Developing Language Skills.* Boston 11: Allyn and Bacon, College Division, 150 Tremont Street. 1959. 527 pp. $6. Helping pupils to speak, write, listen, and develop their creative expression through language is the subject of this new book by two authorities in the field of education. The authors have set forth in practical, meaningful, and useful form an extensive analysis of the known results of current educational research in the language arts field. Written for teachers and parents in a simple, non-technical style, the book presents a comprehensive treatment of: the educational philosophy behind the language program; the psychology of learning as applied to language expression; theoretical and practical approaches to the curriculum; the place of grammar and usage in the language program; language activities and methods, spelling, vocabulary development; and the increasingly important area of listening. Throughout the book, the authors present specific suggestions on practical and proved teaching methods and techniques and tested instructional aids which are in line with currently accepted theories of learning and the best modern philosophies of education.

HECHINGER, F. M. *The Big Red Schoolhouse.* Garden City, New York: Doubleday and Company. 1958. 240 pp. $3.95. Where do American schools stand in the "cold war of the classrooms?" How well are they equipped for the scientific future? Millions of contradictory words have been written and spoken on these two vital questions since the first Sputnik went into orbit. Many of the answers have stated, with frightening statistics, that America is rapidly losing the crucial education race. Others, with equally frightening complacency, have maintained that American schools are the best in the world. It is time for an objective analysis of the education question, one which does not give in to panic or apathy.

The author compares every important aspect of Russian education with American primary and secondary schools. He contrasts the grueling pace of the Soviet school with the leisurely schedule enjoyed by most American high-school students, and clarifies the intricacies of school administration, teacher training, and student testing in both countries. Finally, the author reveals how the Russian educational philosophy squarely contradicts the American credo, "education for education's sake." Can we maintain our democratic ideals and still compete with the Spartan methods of the Soviets?

HENRY, N. B., editor. *Personnel Services in Education.* Chicago 37: University of Chicago Press, 5835 Kimbark Avenue. 1959. 320 pp. $3.25 paper; $4.00 cloth. This fifty-eighth yearbook of the National Society for the Study of Education directs attention, first, to the generally recognized concept of the pupil as a person to be cultivated rather than a person to be molded by authoritarian regimentation and, secondly, signalizes that type of pupil-teacher

support which is implicit in the readiness with which personnel workers in education take their appropriate place in the process aimed at helping each student develop to the limit of his potential.

HUTT, M. L., and R. G. GIBBY. *The Mentally Retarded Child.* Boston 11: Allyn and Bacon, 150 Tremont Street. 1958. 348 pp. This new work was written in answer to the need of those who have responsibility for the care and guidance of retarded children. It seeks to answer the most troubling questions about why a child is mentally retarded and what can be done to help him. The authors are clinical psychologists and teachers with extensive professional experience. They write from the conviction that the mentally retarded child can be helped if we understand the forces that operate within and upon him and the dynamic way in which he attempts to resolve them.

Throughout the book, the retarded child is viewed as a living, developing, adjusting individual with his own needs for love and individual expression. His internal emotional problems, as well as his external behavior, are discussed with insight and understanding. In addition, this book treats such topics as: the personality development of the retarded child; the results of current research in the field of mental retardation; the emotional reactions of the retarded child, along with diagnosis and general treatment; the emotional reactions of parents, together with indications of how these problems may be alleviated; and personality disorders of the mentally retarded child, along with a discussion of their treatment. Consideration is also given to growth-stimulation programs as well as to the treatment of specific reactions. Educational and vocational training programs are discussed in detail.

JEWETT, ARNO. *English Language Arts in American High Schools.* Washington 25, D. C.: Superintendent of Documents. 1959. 128 pp. 50¢. Besides acquainting teachers, supervisors, and administrators with the general content and nature of language arts guides and courses of study, this bulletin may serve as a source of information for curriculum leaders and committees wishing to consider various approaches to producing or revising courses of study. It tells how language arts curriculum committees are organized, how they carry on their work, and the guidelines they follow. It also describes ways in which committees determine scope and sequence for learning activities, how they prepare resource units, and how they provide for individual differences. Finally, it points out the major changes which have occurred in the high-school language arts curriculum since Dora V. Smith's study, *Instruction in English*, in 1932.

JONES, H. M. *One Great Society.* New York 17: Harcourt, Brace and Company, 750 Third Avenue. 1959. 255 pp. $4.50. What is the condition of being human? In an age of nuclear energy, jet propulsion, and space exploration, we have learned to travel quickly, but do we know where we are going, and why? In considering these questions, the author presents a strong and gracefully reasoned plea for the humanities: philosophy, history, literature, music, and the arts and languages. The humanities give purpose, beauty, and value to life. Through them we discover what being "human" really means. Today the universities, business, philanthropies, and government are concentrating on technology in the competition for world leadership. But the inevitable quality of leadership is a moral quality, the author points out. Men must understand themselves before they can lead others; America must base its faith on reason, on art, on knowledge—on humane understanding—if she is to remain great and free.

KAPLAN, LOUIS. *Mental Health and Human Relations in Education.* New York 16: Harper and Brothers, 49 East 33rd Street. 1959. 492 pp. $5. This book presents, systematically, a philosophy of human relations for educators and a practical guide for improving the mental health aspects of education. Here, in a single, up-to-date volume, is extensive, valuable information based on a scientific survey of pertinent research and a review of significant practices and experiences. Underlying the practical suggestions made is a solid foundation of basic facts derived from diverse fields, and well-documented so that the evidence for these suggestions may be examined.

A discussion of the problems of adjustment in our society, the urgent need for improving the mental health aspects of education, and the factors affecting growth and development provides a sound basis for evaluating the long-range purposes of education. The book is divided into four parts. Chapters are introduced with a preview of the content, and are concluded with a summary, a series of problems and projects, and an extensive bibliography. An appendix contains a complete list of audio-visual materials, arranged by chapter and annotated. This book is comprehensive and practical, and is a complete guidebook for teachers, supervisors, administrators, and all those who deal with children.

MOUSTAKAS, C. E. *The Alive and Growing Teacher.* New York 16: Philosophical Library, Inc., 15 East 40th Street. 1959. 169 pp. $3. This book presents a theory of human relatedness and is a portrayal of persons living and learning together. It describes the emotional atmosphere, the conditions and process of learning, and tells what happens to individuals when they are free to be themselves. It is an account of persons struggling with personal and professional issues, problems, and concerns, and their growing respect, acceptance, and love for each other.

The particular group involved is composed of classroom teachers and principals but their experience and the underlying theory are relevant to any person concerned with human relations and genuine life with other persons. To present the philosophy apart from a particular group would make it an abstraction without meaning. Yet the personal experiences explored and the nature of the group life are open for others to see whose lives involve similar concerns and struggles. It is certainly a philosophy of living, of how persons can live together as a group while at the same time recognizing and encouraging the growth of the individual.

ROTHNEY, J. W. M.; P. J. DANIELSON; and R. A. HEIMANN. *Measurement for Guidance.* New York 16: Harper and Brothers, 49 E. 33rd Street. 1959. 392 pp. $5. This book devotes itself solely to testing for guidance. It also utilizes the American Psychological Association's report on "Technical Standards for the Use of Psychological Tests and Diagnostic Instruments." The book presents practices, pointing to their strengths and weaknesses, and offers various criteria to assist counselors in choosing those tests which are likely to be most useful. The focus is on the individual counselee, rather than on groups and group measurement. It pays particular attention to the process of combining test data with those obtained from non-test sources. Furthermore, it differentiates between testing for selection and testing for guidance. While the text presents important statistical concepts in test construction and interpretation, it does not use involved statistical formulae. Practical questions and exercises are based on real cases and real data of the

kind that guidance personnel commonly meet in their work. Pre-service and in-service guidance workers alike will find this volume an invaluable aid.

WEY, HERBERT, and JOHN COREY. *Action Patterns in School Desegregation.* Bloomington, Indiana. Phi Delta Kappa, Inc., Eighth and Union. 1959. 288 pp. $1.50. This is a project of the Phi Delta Kappa Commission on the Study of Educational Policies and Programs in Relation to Desegregation, accomplished with financial assistance from the Fund for the Advancement of Education.

For more than fifty years, Phi Delta Kappans have bent their efforts to the improvement of education through research, service, and leadership. Initiates dedicate themselves to a continuing interpretation of these ideals and swear to uphold free public education as basic to American democracy. Because of their conviction that free public education must be preserved and extended in order to make democracy more perfect, Phi Delta Kappa offers this as a guidebook on school desegregation to beleaguered colleagues, not only to those in the South, but also to schoolmen everywhere in the nation where discrimination against minority groups is practiced and condoned.

ZAPF, R. M. *Democratic Processes in the Secondary Classroom.* Englewood Cliffs, New Jersey: Prentice-Hall, Inc. 1959. 479 pp. This book gives step-by-step assistance to the teacher in achieving success with a democratically operating group of pupils. Using material based on long personal experience, the author takes the reader on a graphic visit to a democratic classroom in action where dynamic methods of instruction can be clearly observed. Comprehensive in coverage, the chapters include procedures which carry a class from the first day through activities which will extend over the greater part of the year.

This book is a how-to-do-it book which points out how to activate a class that is to function democratically; pictures how pupils in action learn the skills of democratic living; provides suggestions for helping pupils learn how to work in small groups and how to establish class goals; describes how problems may be selected and solved by means of group planning, collecting data, and taking notes; places emphasis on how good working relationships can be established with parents; indicates how the basic skills of written and oral communication, as well as social skills, can be incorporated in the activities of democratic classes; gives specific assistance on how pupil-teacher planning in daily and weekly activities can be initiated; and portrays the experiences of boys and girls in a democratically operating class and shows how they recall them after being out of school several years. By the use of photographs and line drawings, the volume shows today's youth in actual democratic classroom situations.

Books for Pupil-Teacher Use

AMRINE, MICHAEL. *The Great Decision.* New York 16: G. P. Putnam's Sons, 210 Madison Avenue. 1959. 251 pp. $3.95. Here is the story of the world's greatest surprise—the atomic bomb, from the moment President Truman learned of its existence until 116 days later—Hiroshima. In secret top-level discussions, the United States leaders asked many of the questions that still haunt us today, in deciding what to do with the new strange force. The scientists had lived with the secret for years, and seen their plans built into great projects—would their advice be heeded? In the underworld of Russian espionage, how much was being stolen and how? What

happened to the special bombing group whose training and orders were so mysterious, before those final maneuvers over Japan?

ANDERSON, DOUG. *New Things To Draw and How To Draw Them.* New York 16: Dodd, Mead and Company, 432 Fourth Avenue. 1959. 56 pp. $2.75. Most people of all ages like to draw, but few can do more than doodle and scribble unrecognizable objects. The author, an established artist and cartoonist, shows how the least talented person can take a pencil and make simple, clear drawings. Step by step, he produces a jet plane, a skyscraper, a giraffe, a face—many such objects, animals, and people—and the frustrated doodler suddenly finds how simple it is to put onto paper a picture.

ANDERSON, POUL. *The Enemy Stars.* Philadelphia 5: J. B. Lippincott Company, E. Washington Square. 1959. 189 pp. $2.95. "They named her *Southern Cross* and launched her on the road whose end they would never see." In this superior novel of life and death in the farthest reaches of outer space, the reader is taken on a voyage which is at once an epic venture and a supreme testing of the human spirit.

ANDERSON, COMDR. W. R., and CLAY BLAIR, JR. *Nautilus 90 North.* Cleveland 2, Ohio: The World Publishing Company, 2231 W. 110th Street. 1959. 254 pp. $3.95. From the dark waters of Puget Sound, *Nautilus* headed north toward the achievement of two historic goals—piercing the Pole and the completion of the first transpolar voyage from the Pacific to the Atlantic. Intricate preparations carried out under strictest secrecy behind them, the crew learned for the first time that the previously announced trip to Panama was a snare and a delusion. The response was superb. Cracked Robert E. Simonini: "I knew there was some reason I saved those two British pounds."

Skipper of the *Nautilus*, Commander Anderson re-creates vividly life aboard the submarine, the suspense of Top Secret orders, the human and humorous incidents that passed the time of the crew, and the unparalleled adventure of the first probe when *Nautilus* came within 180 miles of the North Pole and fulfilled the Jules Verne dream in steaming its 20,000th league under the sea. He shares with the reader the excitement and tension of preparations, mishaps and repairs, omens good and bad, that filled the days before the dramatic announcement of destination North Pole was made.

The author relates, with the immediacy of his on-the-scene participation in each moment, the narrow escapes, the special problems of navigation that had to be overcome, how special instruments were installed in secrecy, the "cover plan" that kept the whole Navy mum, and finally the incredible adventure itself. At 11:15 P.M. on Sunday, August 3, 1958, the first crossing under the North Pole was successfully completed, and Commander Anderson informed the world with the history-making code message "Nautilus 90 North."

ATWATER, M. M. *The Ski Lodge Mystery.* New York 22: Random House, 457 Madison Avenue. 1959. 188 pp. $2.95. When Snow Ranger Brad Davis of the U. S. Forest Service reported for duty at Snowhole, he was looking forward to a quiet season at one of the finest skiing resorts in the country. But complications developed almost immedately. Victor Kohler, internationally known mountain climber, was rumored to be interested in buying Snowhole. His loud bragging antagonized the staff at the ski lodge; yet no one wanted to complain, because he was the guest of pretty Joanne Roland and her multimillionaire father, the owner of the resort.

BAKER, RACHEL. *America's First Trained Nurse—Linda Richards.* New York 10: Julian Messner, Inc., 8 W. 40th Street. 1959. 192 pp. $2.95. In

1873 Linda Richards became America's first graduate nurse. Fighting ignorance and prejudice, she revolutionized medical care in hospitals and instituted reforms which brought her international fame.

BAUS, RUTH. *Who's Running This Expedition!* New York 16: Coward-McCann, Inc., 210 Madison Avenue. 1959. 256 pp. $4. The thoroughly disorganized though sometimes hilarious and exciting adventure on which the author embarked soon brought her face to face with the mysterious river where crocodiles lurked—only slightly more to be feared than the Nicaraguan men and their pinches. Once in the jungle, precariously perched in a dugout canoe, the author found her blond hair and feminine lack of experience could be assets. The native pilots adored her and her fame as "La Reina Rubia del Coco" spread even among the Miskito Indians and Moravina missionaries who dwelt in those parts.

BEISER, ARTHUR. *Our Earth.* New York 10: E. P. Dutton and Company, 300 Fourth Avenue. 1959. 123 pp. $2.95. "Today the earth, its properties, and its strange and violent history find themselves under the inquisitive gaze of the scientists to an unprecedented degree," says the author of this book. The 1957-1958 International Geophysical Year program was set up in an effort to learn more about the earth, from its very center to the outer reaches of its atmosphere, and it is therefore appropriate that the author has written a book which tells of man's search for the facts about the planet on which he lives. He gives the latest information as to the size of our earth, its position in the solar system, its composition and surface, the effects of the atmosphere and the tides and terrestrial magnetism. In a final chapter he gives the most recent conclusons as to the origin of the earth and the solar system, tells why scientists believe the earth's age is 4½ billion years, and how, in a few more billion years, the sun will probably swell to the size of the orbit of Venus and life on earth will perish. The story of the evolution of the earth itself is a dramatic one; and there is equal drama in the story here told of the growth of man's knowledge about the earth.

BENÉT, LAURA. *Famous American Humorists.* New York 16: Dodd, Mead and Company, 432 Fourth Avenue. 1959. 206 pp. $3. Ths addition to the publisher's famous series presents brief biographies of seventeen American humorists, with a sample of the characteristic wit of each. These laughter-provoking authors are: Lucretia Peabody Hale, Frank R. Stockton, Mark Twain, Eugene Field, Henry Augustus Shute, George Ade, Finley Peter Dunne, Stephen Leacock, Booth Tarkington, Clarence Day, Don Marquis, Ring Lardner, Robert Benchley, Edward Streeter, James Thurber, Cornelia Otis Skinner, and Ogden Nash.

BINKLEY, W. E. *The Man in the White House.* Baltimore 18, Maryland: The Johns Hopkins Press. 1958. 324 pp. $6. The Constitution of the United States says very little about the President's specific duties other than the enforcement of the laws of the land. This book reveals how deep-seated forces, inherent in American society and affecting the Presidency for over a century and a half, have transformed the office created by the framers of the Constitution into the complex, powerful, and responsible institution it is today.

The administrations of the "strong" Presidents, each in turn, have added to the powers and duties of the office as we know them. In addition, such social and political forces as the growth of political parties, economic and geographic expansion, and the changing nature of the national government have all had their influence on the Presidency. These processes are historically traced by the

author, and illustrated by examples of how they worked in the case of such holders of the office as Washington, Jackson, Polk, Lincoln, and the two Roosevelts, and Eisenhower.

BOMBACK, E. S. *Contaflex Manual.* New York 17: Morgan and Morgan, Inc., 101 Park Avenue. 1958. 256 pp. $7.95. Since its production in 1954 the single-lens reflex Contaflex camera has established itself as first favorite of the 35 mm. color photographer. This is not to be wondered at, as it combines the standard of excellence of the more world famous Contax camera, with the most simple operation. With nothing more than a set of Proxar close-ups lenses, the Contaflex camera can be used with equal precision in focusing and framing subjects from a few inches to the far distance. The photographer is thus able to select and compose any subject from a butterfly to a landscape with absolute certainty of sharply recording exactly the same area in the transparency or negative, that he can see, lifesize, in the viewfinder.

By reducing the technicalities of photography to a minimum, the Contaflex camera gives the photographer much greater freedom in his choice of picture materal. Indeed, the author of this book believes that the 'one-eyed' reflex camera has opened up a new approach to amateur photography. He compares the camera to a third eye, which soon becomes as easy to use as the natural eyes. This allows a much more subjective approach, and hence a more personal and individual kind of photograph.

This book is, therefore, much more than a conventional instruction manual. In addition to giving working details of all models of the Contaflex camera, the main concern of the author has been to show the much wider scope which such a camera opens up in the art of picture making. As one of the leading exponents on color photography, the author has written the book on the assumption that color can now be regarded as the normal medium for the amateur photographer, with black-and-white as a useful though subsidiary variation. For this reason, this book can also be regarded as a manual of color photography.

An entirely novel chapter has been included which shows how the Contaflex can be made to earn its keep. In fact one doesn't need to be a photo fan to find a use for the Contaflex, as it makes the ideal recording instrument and pictorial notebook for any profession or hobby. The book has been written in the first person, "Because" says the author, "the Contaflex rapidly becomes a very personal camera." It is written for the owner of a Contaflex, be he an expert photographer, or a veritable first-timer. The 200-odd illustrations have all been amply captioned, and many of them are in full color.

BRINCKERHOFF, R. F.; J. B. CROSS; and ARTHUR LOZARUS. *Exploring Physics,* new edition. New York 17: Harcourt, Brace and Company, 750 Third Avenue. 1959. 736 pp. $5.20. This new edition has been especially written for those students who probably will go on to college, and for those students who have an interest in science and an ability to respond to the challenges included in the book. Requirements of standard state and local syllabi as well as those for college entrance have been considered by the authors in the development of this new edition. At the time a student needs practice in mathematics during the discussion of a principle involving a formula, sample problems are worked out and a student problem is given.

The content is up to date. It treats important recent advances in physics, such as earth satellites, the breaking of the sound barrier, and new understand-

ing of the nature of light. It also gives attention to qualified students and encourages them to plan careers in physics.

Tests and learning aids are included at the end of chapters. Special projects for individual investigation are suggested at the end of many chapters. Two separate test booklets accompany the text. There are also a complete glossary, reference tables, and a section of eight full-color plates on light and color. A 192-page laboratory manual of 64 experiments, a combined laboratory manual and workbook including 64 experiments and 128 pages of questions, a teacher's guide, and answer keys are also provided.

BURICKSON, SHERWIN. *Concise Dictionary of Contemporary History.* New York 10: Philosophical Library, 15 East 40th Street. 1959. 224 pp. $4.75. Recent and contemporary events and biographies of persons still living and only recently deceased are found in this handy work in a concise form.

BURTON, ELIZABETH. *The Pageant of Elizabethan England.* New York 17: Charles Scribner's Sons, 597 Fifth Avenue. 1958. 276 pp. $3.95. The first Elizabethan age was unquestionably one of the most colorful and exciting periods of English history. About Elizabeth herself, her great men and their achievements, we know a good deal. But what of the less great and the small, the average citizens of the day—how did they really live? What were their staple diets? What sort of remedies did they keep in their medicine cabinets? How did they occupy their leisure? These are only some of the questions which the author, drawing most entertainingly on a wealth of contemporary sources, seeks to answer.

CHINDAHL, G. L. *A History of the Circus in America.* Caldwell, Idaho: The Caxton Printers, Ltd. 1959. 297 pp. $5. In 1771, a circus rider performed out of doors in Salem, Massachusetts, and collected free-will offerings from bystanders. Today, three-ring circuses exhibit their wonders to many thousands in buildings, under tents, and in ball parks. In this book the author traces the development of the circus in America since 1771, beginning with the small "overland" troupes that toiled along country roads by means of horsedrawn wagons, then continues with the shows that made better time on the railroads, and finally moves on to those that now travel on trucks and house their personnel in trailers.

Originally confined to the Atlantic seaboard, the circus slowly extended its routes to include the cities, plantations, and river landings of the South, the towns and settlements of the Midwest and Far West, and some of the cities of Canada and Mexico. The first transcontinental tour (1869), made in part over the newly completed Union Pacific Railroad and including a detour to Denver over rough mountain roads in cold, rainy weather, tested the endurance of both men and animals.

From the earliest days of the American circus, performances have been given within permanent buildings as well as beneath the open sky and under tents. The term "circus" is therefore used to include both the traveling organization which ordinarily erects its tents on a different "lot" each day and the troupe which fills indoor engagements, sometimes for a week or longer. And since the tented circus commonly comprises an exhibit of caged animals and an auxiliary exhibition containing entertainers and curiosities, the term is extended to embrace the menagerie and the side show.

The Wild West show and the dog and pony show, among the forms of tented entertainment which have come and gone, also have their history sketched in these pages.

Those who are interested in the daily life of the workers and performers will find information about living accommodations and business relationships with proprietors. The numerous illustrations, mostly from photographs, supply additional details, and there is a list of 1,100 circuses, an annotated bibliography, and an index.

CHUBB, T. C. *The Byzantines.* Cleveland 2: The World Publishing Company, 2231 W. 110th Street. 1959. 127 pp. $2.95. Here is the intriguing story of Constantinople and the Byzantine Empire, for hundreds of years the greatest Christian power in the world. Written by a well-known writer and scholar and illustrated with stylistic drawings by Richard M. Powers, it is a fascinating introduction to one of the least familiar but most vigorous and colorful cultures of the world.

CLARK, N. I.; J. B. EDMONSON; and ARTHUR DONDINEAU. *Civics for Americans.* New York 11: The Macmillan Company, 60 Fifth Avenue. 1959. 592 pp. $4.32. This is a course in civics divided into seven units or 32 chapters. It also contains an index, and many charts and maps. The seven units are: Living Together in Our American Way; Living Together as American Citizens; Our Local and State Government; Citizenship Privileges and Opportunities; Working Together for Our Economic Well-Being; and Looking to the Future.

Contemporary Civilization. Chicago 11: Scott, Foresman and Company, 433 East Erie Street. 1959. 207 pp. $1.75, paperback. This book is an attempt to summarize and interpret the significant events and trends of the immediate present, relating them to the past, and projecting them into the future. Combining the resources and techniques of newspapers, magazines, books—and, above all, leading scholars in given fields—it seeks to provide the student with the facts he needs to put the present scene into perspective and to give him scholarly analyses and opinions he can understand and respect.

This book grew out of a definite need, expressed by numerous teachers, for a concise, authoritative coverage of the contemporary scene. Its final form represents the considered judgment of many of those teachers as to the kind of publication which would be most useful in the classroom. Basically, this book is made up of three sections. The first is a narrative of major events and developments around the world from the beginning of 1956 to the present. The second consists of six chapters, arranged topically, presenting scholarly opinions, background information, and analyses concerning the three great "worlds" of our time—the Western world, the communist world, and the Afro-Asian world—the United Nations, science and technology, and the pattern of life in America today. The third section consists of a collection of notable articles dealing with contemporary issues of paramount importance and representing divergent views, an annotated, organized bibliography of publications recommended for a study-in-depth of the twentieth century, and maps and charts for reference. In planning this text, it was felt that even the best historian, working alone, would have difficulty in treating adequately and authoritatively the many areas considered worthy of coverage.

The book has been designed for use with a variety of courses and at different academic levels. First it is planned as a supplement to survey textbooks used in courses in Western and world civilization. In such courses the instructor may use this book as reading material paralleling discussions on modern times or as outside reading to cover that period—the immediate present—which he does not take up in class. In addition, this book is intended for use as the

basic text in courses in contemporary issues, modern problems, and current events and as a supplementary text in all courses dealing with recent history, particularly those which emphasize world coverage.

COOKE, D. C. *Tecumseh—Destiny's Warrior.* New York 18: Julian Messner, Inc., 8 W. 40th Street. 1959. 192 pp. $2.95. Tecumseh was the most extraordinary Indian in American history. This Shawnee chief envisioned the creation of a confederation of all the tribes of the North American continent into one strong Indian nation. For years he devoted all of his energies toward this purpose, attempting to hold his people's land by diplomacy rather than bloodshed. Had he succeeded in his purpose, he would have been the founder of an empire that rivaled in glory that of Mexico or Peru.

CUNNINGHAM, FRANK. *Confederate Indians.* San Antonio, Texas: The Naylor Company, Box 1838. 1959. 258 pp. $5. This history of Stand Watie—the only Indian to attain general officer rank in the army of the Confederate States of America—and his men is recorded here. Most historians have reported that the Civil War came to an end with the surrender of General E. Kirby-Smith. However, there was one unit which refused to quit. This was the fighting force of Stand Watie.

DAVIS, C. E. *The Book of Missiles.* New York 16: Dodd, Mead and Company, 432 Fourth Avenue. 1959. 96 pp. $2.75. For the enthusiast and the student, for every American citizen, here is a quick, pleasant way to a new understanding of missiles—how they operate, the missions they are intended to perform, and how they are helping to lead us to the utilization of space for the benefit of all mankind. Written by a layman, in language a layman can understand, it gives an up-to-date and even forward-soaring perspective from which to judge the over-all missile program of the United States, from the Jupiter to the Matador and from the Bullpup to the X-15.

DUFEK, REAR ADMIRAL G. J. *Through the Frozen Frontier.* New York 17: Harcourt, Brace and Company, 750 Third Avenue. 1959. 192 pp. $3.25. Antarctica, the vast continent at the bottom of the world, was largely unknown except to a handful of men until Operation Deep Freeze—the gigantic program undertaken by the United States as part of the International Geophysical Year. The author, Commander of Operations Deep Freeze I, II, III, and IV, tells the story of this continent—its discovery in the early 1800's, the dangerous early explorations, the vital discoveries recently made—and discusses the future importance of this frozen world.

Wth a vivid and compelling immediacy, the author describes the planning, organization, and carrying-out of the enormous four-year project, extending from 1955 to early 1959. He tells of the first landing of a plane at the South Pole where, to commemorate the event, he planted the American flag in solid ice. He gives a firsthand account of the historic meeting between Sir Vivian Fuchs and Sir Edmund Hillary at the South Pole in January 1958, when Fuchs was completing the first overland trip ever made across the continent. The author participated in many "firsts" during Operation Deep Freeze, and he recounts them here against a broad background of the continent's history and physical geography.

DUGGAN, ALFRED. *King of Pontus.* New York 16: Coward-McCann, Inc., 210 Madison Avenue. 1959. 208 pp. $3.95. Here is told the heroic story of Mithradates, the Pontic monarch who challenged the might of Rome. The Hannibal of his age, who at one moment was "ruler of all Asia, from Taurus to the Propontis, with Roman magistrates led captive before him," this bizarre

combination of Grecian gentleman and Persian tyrant defied Rome for over fifty years. At once a luxurious libertine, who kept a long string of concubines, and a daring statesman, he ordered the massacre of 80,000 Italians living within his borders, and made himself immune from poison by taking small daily doses of it. Finally, the Roman legions of Sulla, Lucullus, and eventually Pompey the Great subdued him. Even at 68, cornered on the distant Bosporus, he evolved a master plan for the invasion of Italy. But he was at last overthrown, not by an army in the field but by a palace intrigue. Surrounded by his own men under his son, Pharnasus, the man who would not die took his own life.

DUNCAN, BOB. *Buffalo Country.* New York 10: E. P. Dutton and Company, 300 Fourth Avenue. 1959. 256 pp. $4. Here is a book alive with the vigor and romance of the Old West, a fascinating collection of stories and legends about the buffalo, the great plains he roamed over, and the men who hunted him down. There are stories here of the early Spanish buffalo hunters, *los ciboleros;* of the mass excursion hunts—actually, mass slaughters—organized by railroads in the post-Civil War years; of how the Indians hunted the buffalo. Here is Western Americana at its best in a rousing book of American folklore and history.

EDWARDS, BERTRAM. *The Mystery of Barrowmead Hill.* New York 18: David McKay Company, Inc., 119 West 40th Street. 1957. 191 pp. $2.75. David Thomas set off on what he thought was going to be a somewhat peaceful vacation, doing lots of swimming, and camping on Barrowmead Hill in the tiny Norfolk town of Barrowmead. But no sooner did he casually mention his plans when the sleepy little hamlet sprang to life with, it seemed, but one thought: to keep David off the hill. On all sides the astonished boy found himself facing not only warnings, but actual threats. Mrs. Ballard, the badly frightened old lady who kept the village store; enigmatic Professor Livermore; uncanny Miss Perryman, the schoolmistress—everybody—told David repeatedly and in no uncertain terms, to stay away from the hill.

EIFERT, V. S. *New Birth of Freedom.* New York 16: Dodd, Mead and Company, 432 Fourth Avenue. 1959. 217 pp. $3. As the minutes ticked toward dawn, Abraham Lincoln waited with an anxiety felt by everyone in the North and in the South. Then a mortar shell exploded in the middle of Fort Sumter, and the War Between the States began. . . . So the author opens this book, her fifth book about Abraham Lincoln, in a fresh and fascinating narrative which carries this sensitive man and great president through four years of war to its tragic, yet triumphant, end in his assassination. The book concludes a series which begins with *The Buffalo Trace,* and is followed chronologically by *Out of the Wilderness, Three Rivers South,* and *With a Task Before Me.* This series as a whole—and especially the final volume—commemorates Abraham Lincoln's 150th Birthday Anniversary—a most worthy tribute.

ETHRIDGE, W. S. *Summer Thunder.* New York 16: Coward-McCann, Inc., 210 Madison Avenue. 1958. 319 pp. $3.95. In her new novel, the author takes a typical young couple, Heather Forsyth and her Bart, and tells the story of their romance, their frequent quarrels, small triumphs, and heart-breaking disappointments and through them reveals both something of the fierce passion of youth and the essential quality of life in Georgia's early days. For the Savannah settlement was dominated by the impressive yet enigmatic figure of General Oglethorpe, who governed it with a firm hand. Heather, all fire and feminine sensibilities, did not approve of everything that the General

proposed for the already divided colonists; Bart on the other hand, weighing matters in his man's way, usually sided with his leader.

FENNER, PHYLLIS. *Something Shared: Children and Books.* New York 36: John Day Company, 62 W. 45th Street. 1959. 246 pp. $4.50. Here are stories revealing the in-most feelings of a child, articles on the joys and problems of reading, and on the importance of books in a child's background. Some of these pieces are long out of print, and can now be found nowhere except in this collection. Scattered through the text are cartoons that also "say" things about children and books so effectively that they too belong in this book.

FLETCHER, G. L., and C. W. WOLFE. *Earth Science,* fourth edition. Boston 16: D. C. Heath and Company, 285 Columbus Avenue. 1959. 564 pp. $5.12. This fourth edition relates the history of the earth, its origin and its past, and what we can know of its future. Considerable space is devoted to topics such as the season, latitude, longitude, and time; the atmosphere, the sea, and harbors; a modern presentation of meteorology from the standpoint of air mass analysis; and a picture of weather as a decisive factor in the lives of aviators, farmers, seamen, and the general public. The last chapter of the text is devoted to a thoughtful discussion of conservation problems and practices.

The book has been brought completely up to date. The new material includes information on certain projects undertaken in the International Geophysical Year, earth satellites, the jet stream, and present theories concerning the formation of the solar system. All statistics have been reviewed and have been revised wherever necessary. The list of reference books given in the Appendix has been expanded.

The text is organized to meet the requirements of classes of varying ability. Sections printed in larger size type may be considered the minimum course. Material printed in somewhat smaller type—and marked with a star—may be profitably used for the faster students. This is a book that high-school classes will enjoy using. Its format is attractive, and the many photographs and drawings are an integral part of the text. Scientifically objective, the text consistently offers a stimulating and challenging presentation of its subject matter. Study aids include completion summaries at the close of each of the 33 chapters. A general review at the end of the text is based on the New York State Regents' examinations. Supplementary materials include *Laboratory Exercises* and a *Teacher's Manual and Key.*

FOSTER, JOSEPH. *Stephana.* New York 16: Duell, Sloan and Pearce, Inc., 124 E. 30th Street. 1959. 224 pp. $3.50. Stephana, just old enough to be seriously in love, was probably the most lovely as well as the most intelligent girl of high-school age in Alburquerque. But Stephana, living with her family in a rundown ranch on the outskirts of town, was profoundly unhappy. Every member of Stephana's family reacted in his own individual way to the powerful and all-pervasive forces of discrimination turned against their strangeness. To achieve any kind of freedom or any worth-while goal in life, Stephana first had to disguise herself and—above all—to conquer the fierce pride that was her first heritage.

FRY, HUMPHREY. *If the Cap Fits.* New York 36: John Day Company, 62 W. 45th Street. 1959. 190 pp. $3.50. Behind the ivied facade of a private boy's school in a big city, the problems facing a headmaster are often far removed from the serenity and pedagogy usually associated with such institutions. Boys are seldom anything but boys and never to be underestimated, but,

when their schoolmasters also act like adolescents, they are infinitely more difficult to comprehend or advise or discipline.

FUCHS, SIR VIVIAN, and SIR EDMUND HILLARY. *The Crossing of Antarctica*. Boston 6: Little, Brown and Company, 34 Beacon Street. 1958. 348 pp. $7.50. This books tells the story of the Commonwealth Trans-antarctic Expedition, completed when the two groups, who traveled the last 700 miles together, reached Scott Base 99 days later—just one day under the crucial time limit set by Fuchs. Beginning with the landing of the advance party in November 1955 to establish a base on the Weddel Sea, when, like Shackleton before him, Fuchs found his ship trapped by ice, it tells the story of the two years of preparation and reconnaissance that led up to the final attempt.

GARST, WARREN and SHANNON. *Ernest Thompson Seton—Naturalist*. New York 10: Julian Messner, Inc., 8 W. 40th Street. 1959. 192 pp. $2.95. In his varied and exciting career, Ernest Thompson Seton was a great naturalist, a distinguished painter of wild life, and a best-selling writer of animal stories. He was also organizer of the Woodcraft Indians which later became the Boy Scouts of America. As a child, Ernest roamed the woods of Canada, dreaming of becoming a naturalist but never hoping to succeed, since his father bitterly opposed this dream. Young Seton slipped off into the woods to study nature in secret, and at sixteen was a self-trained scientist, keeping accurate accounts of every animal, bird, and plant he saw. He did not neglect school, for education was his only means of escaping intolerable conditions at home, and he hoped to persuade his father that there was a future in being a naturalist. However, his father insisted that he study art and sent him to London where Seton won a scholarship to the famous Royal Academy.

Here he combined his two extraordinary talents—art and science—painting the animals he knew so intimately and loved so well. After a short stay in Canada, he went on to New York where, unknown and penniless, he fought for recognition as a writer and an illustrator. Just when he began to sell his animal stories, he was threatened by blindness. Here is the colorful story of a man who lived adventurously, succeeded in spite of a physical handicap, and became legend among naturalists and lovers of wild animals and the great outdoors.

GARTH, DAVID. *The Watch on the Bridge*. New York 16: G. P. Putnam's Sons, 210 Madison Avenue. 1958. 320 pp. $3.95. February 1945 found the German Wehremacht everywhere in retreat before the advancing British and Americans, falling back on the Rhine, ready to cross that historic barrier, blow the spans that traversed it and then, in safety, recuperate for the struggle that would decide the fate of the Fatherland itself. It was natural for all eyes to turn to the north, to the wide reaches of the lower Rhine where the ultimate assault would be mounted. But this is a story of another sort and place —of a town standing beside the rushing waters of the upper Rhine and of a bridge, a four-hundred-year steel ribbon over a river that flowed deep and swift between the cliffs. It is the story of how that doomed country cousin of a bridge became, in the span of minutes, the most important bridge in world history.

GASKILL, A. L., and ENGLANDER, D. A. *How To Shoot a Movie Story*. New York 17: Morgan E. Morgan, Inc., 101 Park Avenue. 1959. 136 pp. $1.95. All the basic techniques for making effective, interesting movies are described and illustrated in this manual by two movie experts. Professionals

and amateurs alike will find help on how to create entertaining, compelling films that command audience attention. Production and planning methods, as well as step-by-step instructions and illustrations will enable anyone to turn out a well-knit, well-paced film, regardless of equipment. The techniques and tips apply equally to features, TV programs and commercials, documentaries, industrial, educational, or personal home movie films. This book will prove a valuable aid for motion picture and television studios, advertising agencies, schools and colleges, industrial and research organizations, home movie makers, and camera clubs.

GILBRETH, L. M.; O. M. THOMAS; and ELEANOR CLYMER. *Management in the Home.* New York 16: Dodd, Mead and Company, 432 Fourth Avenue. 1959. 299 pp. $5. Homemaking is a vocation of supreme importance, and this book is written with the needs and interests of the homemaker in view. Its aim is to show her how to plan a fuller and more productive life for herself and her family by making use of some simple, common-sense principles. These are the principles of work simplification. These methods get their start in industry, where better working conditions and less fatigue soon showed profits.

This book will do for those in the home what engineers have done for industry in the factory. It shows, clearly and practically, how to get the most out of available money, time, and energy through better planning and management. It does not, however, deal only with techniques of housekeeping. The most important things in the home are not the equipment and appliances, but the people who use them. Good family relations are the foundation stones of good home management and the basis of human relations in the world outside the home. This book takes them into account in helping the student to plan her life and work.

HATCHER, HAZEL M., and MILDRED E. ANDREWS. *Adventuring in Home Living.* Books 1 and 2. Boston: D. C. Heath and Co., 285 Columbus Avenue. 1959. 512 pp. each. $4.80 each. Book 1, revised, a basal beginning text for young adolescents in homemaking education, has been developed in terms of three goals which the authors have attempted to achieve—to write a book that students will enjoy, to exemplify teaching procedures which are educationally sound, and to write at the reading level of young teenagers.

Throughout the book an earnest attempt has been made to lead students to analyze their own problems, to carry on helpful experiences, and to evaluate their own progress. Emphasis has been placed on informal evaluation and self-evaluation through devices developed cooperatively by pupils and teachers, and used as a group or individually. In this way, students learn to evaluate themselves as individuals, and also tend to build up better person-to-person relationships not only with boys and girls their own age, but also with members of their families and with people in the community.

The book offers suggestions on how other classes can use the material to the best advantage, and includes many experiences which may help these classes to carry out their own objectives. It is believed that the book will facilitate the work of teachers who do cooperative planning in their classrooms. It should also encourage other teachers to use this procedure—teachers who would like to do cooperative planning, but who need help in getting started.

As further assistance in working cooperatively with students and parents, a guide for using Book 1—and its companion, Book 2—has been prepared. This guide should answer many questions on cooperative planning which arise as

classwork progresses. Particular emphasis has been placed on techniques for using the book itself.

Book 2 is a basal text for boys and girls in homemaking classes, similar in form and content to Book 1. One of its chief values to teachers lies in the easy transition which is made from the level of learning in Book 1 to that of a higher level in this book. This means that the students and the teacher who start out in Book 1 in the various areas, such as child development or foods, can progress easily and naturally, without undue repetition, to the more advanced study of these areas in Book 2. In fact, the material in the two books is so integrated that no time need be spent trying to make one book fit in with the other. It also seemed important to develop Book 2 in terms of the three goals used in Book 1—to offer a basal text that students will enjoy, to exemplify teaching procedures that are educationally sound, and to write at an optimum reading level for young people.

The cooperative teaching procedures developed in Book 1 are continued in Book 2. They involve student-teacher participation in planning, setting up, and carrying out class goals which are based on the students' personal and family problems. The students are encouraged to clarify these goals in terms of their own behavior—that is, how it is hoped they will think, feel, and act about the problems. This leads to the planning of school and home experiences that will help to achieve the desired results. Generalizations and information relating to the goals are assembled as the experiences are being carried out. Emphasis is placed on self-evaluation in attaining the goals through procedures developed cooperatively by the students and teacher. The authors believe that whereas Book 1 has facilitated the work of the teachers who do cooperative planning, or has encouraged other teachers to try this procedure, Book 2 will be equally helpful in increasing the quality of classroom teaching.

The reading level of the book is slightly higher than that of Book 1, and coincides with the anticipated development in knowledge and understanding of growing adolescents. The informal or personal approach, which implies the use of fairly short sentences that can be easily understood, has also been used in this book, though to a lesser degree than in Book 1. But all of the material is expressed in terms commensurate with the reading comprehension of young people at this stage of their development.

HEAVEY, REGINA, and H. L. STEWART. *Teen-Age Tales*, Books A and B. Boston 16: D. C. Heath and Company, 285 Columbus Avenue. 1959. 256 pp. each. $2.56 each. Books A and B are the newest books in the series. Like the other six books in the series, they were designed for the student who is a slow reader or the student who doesn't like to read. Books A and B are written on a third-grade reading level, but they maintain a teenage level of interest. Here are stories and articles about adventure, sports, science, and young people and their interests—a panorama of the high-school student's world. None of the pieces is over-long or over-complicated; all of them have a fast pace and good tale to tell. The books are of a comfortable size, and their bright "picture" covers, lively colorful illustrations, and easy-to-read type encourage students to start reading and to keep it up.

HEYER, GEORGETTE. *Venetia*. New York 16: G. P. Putnam's Sons, 210 Madison Avenue. 1958. 308 pp. $3.95. Venetia Lanyon had an independent spirit, calm good sense, a lively sense of humor, and an equable disposition—and she had need of all. What she did not realize was that she also had quite a breath-taking beauty that was wholly wasted on the Yorkshire

moors where she had been kept by a recluse of a father. Now Venetia is twenty-five and managing the family estate for her brother, Conway, who is with the army occupying Europe after Waterloo, and taking care of her lame younger brother, Aubrey. Her only suitors have been the stuffy Edward and the flighty and adolescent Oswald. And there seems to be no release for her until Conway returns.

HILL, C. C. *Spring Flowers of the Lower Columbia Valley.* Seattle 5, Washington: University of Washington Press. 1958. 174 pp. $3. Amateur botanists exploring the woods and countryside are often handicapped by lack of a regional handbook on the flowers they discover. This book has been prepared to fill the need for a guide to the spring-blossoming wildflowers and flowering shrubs of the lower Columbia Valley. The introduction and glossary define the technical terms and a simplified key helps the amateur identify the flowers easily. Seventy-one full-page drawings complement the detailed descriptions and classifications.

In addition, there are notes on the naming, special qualities, and unusual uses to which many plants have been put. Thus, in discussing the genus *Rosa*, the author tells that during World War II 500 tons of rose hips from English hedgerows were made into a syrup said to contain as much vitamin C as 25,000,000 oranges. Indian uses of the plants are mentioned. Ocean spray, for instance, was used for making arrow shafts, and camas bulbs are still boiled, fried, or pounded into flour by the Warm Springs Indians for the annual root festival of thanksgiving to the Great Spirit.

The author also offers suggestions for the cultivation of wildflowers that can be transplanted successfully. Since many Columbia Valley flowers are found over a wide area of the Pacific Coast or were brought to the United States or to the West by explorers and pioneers, the distribution of each plant is given. Occasionally a flower is traced around the world.

History of the Modern World. Ann Arbor, Michigan: The University of Michigan Press. 1958. $35. After the Marshall Plan, the North Atlantic Treaty Alliance, and the Korean War, all thoughtful people knew that the United States had irrevocably accepted the leadership of the free peoples of the globe. As the one-time isolationist Senator Arthur H. Vandenberg had put it, Americ a's self-interest, national economy, and security were now inseparably linked with the destiny of other peoples. Like it or not, Americans had to take anxious account of events in Russia and try to grasp what George Kennan called "The Sources of Soviet Conduct." They had to follow the debate between Secretary Acheson and his critics whether China's fall to the communists was to be blamed wholly on internal Chinese forces—or in part on American policy. They had to worry over the prospects of democracy in Italy and in Indo-China, the burdens with which a dying imperialism had saddled France, and the chances of Adenauer's government.

But all too often a comprehension of the fast-changing world situation was difficult because people lacked any real knowledge of the historical background of current events.

Books were required; they were written and issued. But one grave want remained unfilled. It was the need for a series of volumes offering to the public at large an interconnected view of the histories of the great modern powers, comprehensive and scholarly in content yet lively in style. They should deal with the histories of the major nations and power areas, and emphasize the record of the last one hundred years. They should be written by men distin-

guished in their fields, men who had proved their ability to present the past with clarity, color, and drama.

Professor Allan Nevins of Columbia University, himself a historian, author of more than a score of books and twice a Pulitzer prize winner, desired to make this enterprise a reality. He devoted nearly ten years—at first alone, later in cooperation with Professor Howard Ehrmann of the University of Michigan—to the selection and guidance of contributors. The result of his labors and theirs is a series of books intended to present political, social, and cultural history combined. The University of Michigan's *History of the Modern World* will consist of some fifteen volumes, illustrated with maps especially drawn for the series, printed on good paper and bound in buckram. Each volume will contain over 500 large pages.

Publication began in the fall of 1958. The first four volumes are devoted to the four great power areas outside the United States: *Russia and the Soviet Union* (679 pp. $10) by W. B. Walsh; *The Near East* (515 pp. $7.50) by William Yale; *The Far East* (508 pp. $7.50) by Nathaniel Peffer; and *Latin America* (614 pp. $10) by J. F. Rippy. These four volumes, contained in a durable, attractive open-sided box, are available for a total of $35. Now in preparation are: *Canada* by the late J. B. Brebner; *France* by Albert Guérard; *Italy* by D. M. Smith; *The United States to 1865* by Michael Kraus; and *The United States Since 1865* by F. R. Dulles.

HOBART, LOIS. *Elaine Forrest—Visiting Nurse.* New York 10: Julian Messner, Inc., 8 W. 40th Street. 1959. 190 pp. $2.95. Elaine Forrest felt drawn to nursing because her mother had been hospitalized for a long time and then her father. Being in and out of hospitals for years, seeing the selflessness and dedication of the nurses made her wonder what it was like to hold a life in her hands, to battle with disease and death. She didn't have to go to work; she had wealth, social position, and a romantic future with Bryce Thorne. But she became a nurse.

HOOK, J. N.; L. C. GUILD; and R. L. STEVENS. *English Skills.* Boston 17: Ginn and Company, Statler Building. 1959. Book 9, 460 pp. $3.60; Book 10, 480 pp. $3.68; Book 11, 476 pp. $3.76; Book 12, 480 pp. $3.92. This is a series of texts in composition for grades seven through twelve. The series covers all aspects of English communciation which experienced teachers of English deem vital to any successful program of English. Each chapter begins with clearly stated goals; thus, the student knows at once where he is going. The basic understanding of the principles of communication is achieved by the method of thinking. That is, the student begins with a familiar everyday language situation, develops the knowledges and skills that he needs to meet the situation successfully, applies his new knowledge and reinforces his developing skills, finds his own strengths and weaknesses, corrects his weaknesses, and thus experiences the satisfaction of success. Through success the student develops an eagerness to face and master new challenges, an essential factor to growth in learning. Thus this series helps the teacher to realize a fundamental aim; namely, to teach the student to develop his ability to think through acquisition of language power, the basic tool of thinking.

The series is organized according to three fundamental steps in learning: understanding, practicing, and testing. Thus each topic is treated according to a three-part plan: study (or teaching) exercises, practice exercises, and testing exercises. The study exercises lay the groundwork of understanding upon which the busy English teacher can build a teaching program to suit the

varying needs of the class. Time and energy normally spent in the preparation of class or teaching material are now released for studying the individual needs of students and prescribing the remedies found in abundance in the text. These exercises consist of small, clearly labeled problems, each developing one or more basic rules or definitions which the student must understand and use in order to improve one or more of his language skills. Each problem for study is followed by questions, with the final question specially designed to teach the student to summarize what he has learned and to check the accuracy of his conclusion against the clearly formulated rules and definitions grouped at the close of the study section.

The practice exercises offer a variety of interesting and practical drills that illustrate the basic principles, reinforce them in the student's mind, and help the student to develop the language skills needed for success. The testing exercises are designed to show the student whether or not he understands and can apply the principles learned. Frequently this last step provides for both self-evaluation and class judgment of success. All exercise headings throughout the three-part treatment of a topic permit the student and the teacher to tell at a glance the problems treated or the essential principles to be learned, practiced, or tested, with the most challenging exercises labeled as such.

HORNER, E. D. *Jungles Ahead!* New York 10: Friendship Press, 257 Fourth Avenue. 1959. 128 pp. $2.95. "In Africa there is more than one jungle," says the author in the Foreword of this book. There are jungles of forest, grass, sand, and cities, she tells us. There are also political and social jungles in which Africans seek a new life in freedom. But none of the jungles, the author insists, is impenetrable. The six true stories in this book are about young men and women who have discovered that there is no jungle so dense that it cannot be penetrated with the "light that shines in the darkness."

JENKINS, ELIZABETH. *Elizabeth the Great.* New York 16: Coward-McCann, Inc., 210 Madison Avenue. 1958. 336 pp. $5. The young Elizabeth was never entirely safe, her position rarely secure. The advisers of her Catholic sister, Mary Tudor, urged that she be put to death, saying, "The Princess Elizabeth is greatly to be feared, she has a spirit full of incantations." But Elizabeth outlived Bloody Mary and came to the throne—even though at her coronation no bishop could be found to put the crown on her head.

Queen at last, Elizabeth brought with her to the throne extraordinary gifts which were manifest from the very beginning of her reign—an unfailing instinct for choosing her advisers; the great personal magnetism which made her an object of adoration to her subjects; the financial genius which contributed so largely to the later prosperity of the realm; and the apparent vacillation which was to be such a strong weapon in her diplomacy.

JOHNSON, L. H. *Red River Campaign.* Baltimore 18, Maryland: The Johns Hopkins Press. 1958. 329 pp. $5. The story of the Red River Campaign, which took place in Louisiana and Arkansas in the spring of 1864, is here told fully. In response to the demands of Union Free-Soil interests in Texas, and the need of New England textile manufacturers for cotton, an expedition was undertaken to open the way to Texas. General Nathaniel Banks conducted a combined military and naval expedition up the Red River in a campaign that only lasted from March 12 to May 20, 1864, but was one of the most destructive of the War, before ending in Bank's defeat at the Battle of Sabine Crossroads.

JONES, JAMES. *The Pistol.* New York 17: Charles Scribner's Sons, 597 Fifth Avenue. 1958. 158 pp. $3. Pfc. Richard Mast does manage to keep the pistol assigned to him for guard duty, and the struggle around it provides the pathos, savagery, and humor of the story. In the chaos of those first days and weeks of war, as Mast and his companion move from Schofield Barracks to the beaches of Oahu, then to a remote mountain pass, the pistol dominates the action. Every sort of effort is made to get it away from Mast—by offers of money, by threats and cajolery, by theft, and by violence. But he is obsessed by his need for the weapon: it becomes for him, and for the men around him, a symbol of personal salvation, for which any one of them will make any sacrifice.

JOY, C. R. *Young People of the Eastern Mediterranean.* New York 16: Duell, Sloan and Pearce, 124 E. 30th Street. 1959. 187 pp. $3.50. This book presents a new approach to an understanding of the everyday life of young people in ten countries of the world today. The ten lands are Egypt, Lebanon, Greece, Yugoslavia, Libya, Cyprus, Turkey, Iraq, Jordan, and Israel. In each of these a pair of youngsters, boy and girl, has been found to tell, in his or her own words, the facts about their way of life: families, homes, education, food, recreation, and other interests. The author has taken care to present a balanced picture; if the boy who is interviewed is poor, then the girl presents the pattern of living of a well-to-do-family.

Junior Hi-Y Manual for Leaders. New York 7: Association Press, 291 Broadway. 1959. 160 pp. $1.25. Presents club programs as a framework within which principles of organization and methods of good group work have been crystallized in common terms.

KEELON, J. K. *Tested Problems for Calculators and Listing Machines.* Englewood Cliffs, New Jersey: Prentice-Hall. 1959. 77 pp. $1.48. The greater part of this book is made up of practical, thought-provoking business problems. Very little effort has been directed toward instructing the pupil in machine operation. Except for the first few pages—which do present certain exercises to develop touch addition on ten-key listing and key-driven machines, along with exercises in discounts, net amounts, decimals, and a brief explanation of handling fractions through the use of decimal equivalents—the book is devoid of instructional material. For operating procedures the teacher is referred to machine company manuals that are complete and up-to-date.

These practical business problems have been planned to give the student the exact type of work he is likely to meet in business. Some of these problems do require some thought; but with the brief explanation given, the student should have no trouble in completing his assignments.

After the student goes through the book once and is transferred to another machine, he will follow the work in Part I for his new machine, but he will repeat the rest of the book. In the course of the year, the business problems will be worked out four times if the pupil has access to the four types of machines. As the year progresses, the teacher's chore is lightened, as there is less need for discussing the problems and explaining objectives. The student's interest increases as he repeats a familiar problem with different equipment, and the quality and accuracy of his work improves. There is no monotony or boredom because he sees in these problems realistic business situations.

KENNEDY, E. C., and BERTHA TILLY, editors. *The Story of Trojan Aeneas.* New York 22: Cambridge University Press, 32 East 57th Street. 1959. 157 pp. $1.25. Extracts in Latin from Vergil's *Aeneid,* Books I, II, and III. It is a connected story of Trojan Aeneas, which belong to the very heart

of the Rome of Augustus and of the thought of his age. Also includes notes. A one-semester course.

LAMB, GENE. *Rodeo Cowboy*. San Antonio, Texas: The Naylor Company, Box 1838. 1959. 191 pp. $3.95. The men who risk their necks within the bone-crunching confines of the world that is Rodeo and the women who watch (often with their hearts in their mouths) from the stands comprise a separate breed, as distinct and individual as the members of any highly skilled and highly precarious profession. This is their saga. It is set down with an understanding and pathos and a painstaking and wholly admirable attention to detail which followers of the sport will find both satisfying and absorbing.

It is, in a very particular sense, the story of Hutch Doyle, and of his quest for success and fulfillment in what must be accepted as one of the most highly competitive sports extant—Hutch, who roamed the country with his wife and family to whatever corner of the nation beckoned with the lure of rich rewards and high excitement; who picked himself up from the dust of the arena turf time and time again, to mount and ride, and ride again. That the Rodeo Cowboy speaks a lingo peculiarly his own is beyond dispute, and there is, as the story of Hutch Doyle makes manifestly clear, no word, in that lingo, for quitter.

LAMB, HAROLD. *Hannibal*. Garden City, New York: Doubleday and Company, Inc. 1958. 310 pp. $4.50. Hannibal was known for his military genius, but his overland campaign against Rome with foot soldiers, cavalry, baggage train, and elephants astonished the ancient world and has amazed historians ever since. Later he proved by masterful reorganization of the defeated Carthaginian government that he was as fine a statesman as soldier. This is a great story of the man who has been called the world's finest soldier, by an author who is celebrated for his authentic, vivid biographies of military leaders. All the variety, excitement, and glory of Hannibal's tumultuous life lives again in this stirring saga of the mightly Carthaginian who, even as an old man in exile in Syria, filled the powerful Romans with dread.

LEONARD, J. N. *Exploring Science*. Cleveland 2, Ohio: The World Publishing Company, 2231 W. 110th Street. 1959. 319 pp. (8″ x 11¼″) $4.95. Astronomers, reaching out with their telescopes, analyze the light of distant stars and tell us what they are made of; geologists know the composition of the earth's core; the atmosphere around us, the oceans, even our neighbor planets are giving up their secrets. All of this and more—how life began on earth; why the earth has land; rain, snow, and thunderstorms; the sun and moon; planets and outer space—are discussed in the first part of this book.

The second part is the story of man in the world and how he is learning step by step to control forces of nature much greater than he is. Here is anthropology, what we know about the rise of the human species, and how men learned to live together in groups. And here, too, is the remarkable story of how new habits of thinking—what we now call scientific method—revolutionized all branches of science and catapulted man into a world of jets, antibiotics, electronics, atomic energy, and automation.

LESSENBERRY, D. D.; T. J. CRAWFORD; and L. W. ERICKSON. *20th Century Typewriting*, Seventh Edition. Cincinnati 27, Ohio: South-Western Publishing Company, 5101 Madison Road. 1957. 354 pp. The first edition of this book, published in 1927, made a contribution to better and more efficient teaching and learning of typewriting. Each of the succeeding editions, in its turn, has made additional contributions to building typing skill

more easily, more rapidly, and more thoroughly. The seventh edition is another advancement. It will lead to better teaching with resultant higher speeds with control in less time. New, different, and challenging techniques and devices that have been proved through a careful process of classroom experimentation, evaluation, and refinement have been added to those features that have been classroom proved in previous editions.

LOVE, J. P. *How To Read the Bible.* New York 11: The Macmillan Company, 60 Fifth Avenue. 1959. 191 pp. $3.95. This book is a helpful guide for readers who really want to understand and fully appreciate the Bible. The Biblical text is considered in terms of natural units of thought—that is, passages are presented not only as an over-all theme, but texts in which the same characters and situations appear are given alongside one another. Thus, the thematic relationship of Biblical texts is clearly established and more readily learned.

LUBKE, ANTON. *The World of Caves.* New York 16: Coward-McCann, Inc., 210 Madison Avenue. 1958. 295 pp. $5. This book considers caving both as an exciting hobby and for its practical value. It aims to explain what impels the speleologist to penetrate the dark cavities of the earth; to describe the dead and living things he finds there; and to show the geological and historical significance of caves.

MARTIN, MOLLY. *Bill Martin, American.* Caldwell, Idaho: The Caxton Printers, Ltd. 1959. 263 pp. $5. This narrative presents the high points of Bill Martin's adventures from childhood to the end of World War II as it unfolds the story of an immigrant boy who became a real American.

MASON, A. T. *The Supreme Court from Taft to Warren.* Baton Rouge 3, Louisiana: Louisiana State University Press. 1958. 266 pp. $4.95. The last half century has been one of turmoil and change, a period of testing and conflict in our society. The executive, legislature, and judicial branches of government have been focal points of controversy: judicial slaughter of legislation in the early thirties; Roosevelt's retaliatory "court-packing" attempt in 1937; judicially sanctioned Federal interference in economic affairs; the bitterly contested segregation decisions of 1954; the explosive rulings of 1957.

In an age of shattered precedents, the Supreme Court, normally a stabilizing force, has itself been a major participant in leveling familiar landmarks. As so often in the past, the Judiciary's failure to observe the fine line between judicial review and judicial supremacy has made it the storm center.

The author undertakes to show how the Court and its Justices were themselves on trial during much of this time—how they were subjected to pressures from without and conflicting philosophies within. He also demonstrates how the Court's action often tended to further, even while it cloaked, judicial preeminence.

He dispels the fiction that the judicial process operates in a vacuum, above personal and political considerations. To this end, he skillfully examines the dicta of various Justices—particularly, Holmes, Taft, Hughes, Brandeis, Frankfurter, Stone, Douglas, and Warren—against the background of events with which they were concerned.

MAZOUR, A. G., and J. M. PEOPLES. *Men and Nations.* Yonkers-on-Hudson, New York: World Book Company, 313 Park Hill Avenue. 1959. 812 pp. This text is divided into ten parts and fifty-six chapters. The index is a classified directory for the book to be used as a way to find names and topics and as a guide to pronunciation for new or difficult words. Each of the

ten parts of the book opens with an introductory picture and a page of text. These pages point up great themes to watch for in the coming chapters. These introductions will help the pupil to read thoughtfully, watching for the main ideas.

Following the introduction to each part the student will find a time chart for that section of history. These charts will help him to see the relationship of major events to one another. A look down the columns of a chart shows the order of events in different areas of the world. At the end of each chapter he will find a review section. If he is familiar with the "People, places, and things" listed, and if he can answer the questions under "Events in review," he has covered the main points of the chapter. The "Problems and projects" sections contain suggestions for discussion, debate, or extra study.

Each of the ten parts ends with a brief review of that part. These questions are to help the students to keep track of major themes within each part and trace themes from one period of history to another. Each part has its suggested reading list. He may want to learn more about a person or an event than one book can tell him. Any book listed can add something valuable to his knowledge of history. A list of basic reference books is found at the end of this introduction.

Accompanying the text are 82 specially prepared maps. Each map was drawn to help the student to visualize some fact of history, such as the geographic location of Italy or the campaigns of World War II. In the back of the book there is a 16-page map supplement in full color. These maps show highlights of world history and geography. They are a handy place to find cities, seas, nations, and other world features. The book has hundreds of illustrations. These range from a drawing of a stone axe to a diagram of a medieval manor to a photograph of an earth satellite. They have been selected to help make clear what the text is saying, or to tell him a little more about a topic. The captions point out features in the illustrations and relate them to the text.

To add further information and interest, the book has four special sections in full color. These show samples of the world's civilization at different periods. Such things as Egyptian wall paintings, Greek temples, medieval stained glass windows, and eighteenth-century costumes are shown in full color. All these parts of the book are planned to work together to enable students to acquire an understanding of the past that will help them to live wisely in the present.

McALPINE, WILLIAM and HELEN. *Japanese Tales and Legends.* New York 3: Henry Z. Walck, Inc., 101 Fifth Avenue. 1959. 220 pp. $3.50. This book begins with the early tales of the legendary past of Japan after its mythological birth when gods still walked its tiny islands. It goes on next to the epic legend of the Heike, the noble race of warriors, whose stories are still re-enacted in the Japanese traditional theater. Then, the authors retell the folk tales of woodcutters and fishermen who enter strangely enchanted worlds; of fairy children who bring joy to their human parents; and of animals endowed with magic powers. The twenty-eight tales in this collection contain mischief and humor; but, over all, a deep sense of the magic, the ceremony and wonder of life.

McKOWN, ROBIN. *Painter of the Wild West—Frederic Remington.* New York 10: Julian Messner, Inc., 8 W. 40th Street. 1957. 192 pp. $2.95. The most exciting paintings of Indians and the Wild West are those of Frederic Remington. They capture the real feeling of the West because he himself lived the stories he told in pictures. After only a year and a half of training at Yale's Art School, Remington first went West in 1881 when he was not yet

twenty. It was there he realized that the Old West was about to vanish forever and decided to preserve it in sketches. Remington sold his first magazine illustration for ten dollars; today some of his canvases sell for $20,000. Once he became an established illustrator, he was much in demand as an artist. He illustrated Longfellow's *Hiawatha* and Theodore Roosevelt's cowboy articles. With Richard Harding Davis, he reported the Cuban crisis, and, as a war correspondent under fire, his camera-like brain recorded details of battle which became masterpieces on canvas.

MEADER, S. W. *The Voyage of the Javelin.* New York 17: Harcourt, Brace and Company, 750 Third Avenue. 1959. 189 pp. $2.95. This is the story of a boy who lived a hundred years ago, when the towering, square-rigged clipper ships were setting records never surpassed in the annals of sail. Young Bob Wingate watched the *Javelin* being built in a shipyard at Portsmouth, New Hampshire, and he was in the cheering crowd that saw her launched. Then, by a great stroke of luck, he was fortunate enough to be given a berth aboard her as ship's boy on her first voyage.

MEEKER, ODEN. *The Little World of Laos.* New York 17: Charles Scribner's Sons, 597 Fifth Avenue. 1959. 256 pp. $4.50. This ancient, tiny country, the land of the Million Elephants and the White Parasol, Oden Meeker says, "is surely one of the most appealing nations in the world." And he goes ahead to prove his point, with affection and humor. The Lao decorate their light, airy houses with graceful curlicues; they delight in festivals, sacred and profane. A gentle, pacific people, they have no martial spirit.

MILLER, J. H. *Charles Dickens—The World of His Novels.* Cambridge 38: Harvard University Press, 79 Garden Street. 1958. 364 pp. $6. George Orwell once said of Dickens' work: "It is not so much a series of books, it is more like a world." In this book, the author attempts to identify this "world," to show how a single view of life pervades every novel that Dickens wrote, and to trace the development of this view throughout the chronological span of Dickens' career. There are full critical analyses of six of the novels—*Pickwick Papers, Oliver Twist, Martin Chuzzlewit, Bleak House, Great Expectations,* and *Our Mutual Friend*—and shorter discussions of many of the others. Each novel has been viewed as the transformation of the real world of Dickens' experience into an imaginary world with certain special qualities of its own.

Certain elements persist through all the novels, the most important of which are the general situation of the hero at the beginning of the story and the general nature of the world in which he lives. Each of Dickens' heroes begins his life cut off from other people, in a world which seems menacing and unfriendly and, on the social side, composed of inexplicable rituals and mysterious conventions; each lives, like Paul Dombey, "with an aching void in his young heart, and all outside so cold, and bare, and strange."

The heroes then move through successive adventures in an attempt to understand the world, to integrate themselves in it, and thus to find their true identity. Initially creatures of poverty and indigence, these characters reach out for something which transcends the material world and the self, something other than human, which will support and maintain the self without engulfing it. Within the totality of Dickens' novels this problem—the search for selfhood—is stated and restated, until, in the later novels, the answer is found to lie in a rejection of the past, the given, and the exterior, and in a reorientation toward the future.

MONTGOMERY, RUTHERFORD, and COLONEL GROVER HEIMAN. *Jet Navigator.* New York 16: Dodd, Mead and Company, 432 Fourth Avenue. 1959. 223 pp. $2.75. Aviation Cadet Bob Williams decided that being a jet pilot in the United States Air Force would be even finer as a future career than playing pro football, only to be told that he would have to give up this ambition because of an imperfection in his vision. Rebellious, he was transferred to navigator training. It took a terrific test of courage and ability to navigate, as well as pilot, a B52 with an armed enemy agent abroad, threatening the safety of crewmen and zooming plane, to bring him to the realization of the invaluable part a navigator plays on the team of a SAC jet.

MOSCOW, ALVIN. *Collision Course.* New York 16: G. P. Putnam's Sons, 210 Madison Avenue. 1959. 316 pp. $4.50. This is the definitive account of the most controversial sea disaster in history—the collision of the Italian *Andrea Doria* and the Swedish *Stockholm* on the night of July 25, 1956.

NANDA, B. R. *Mahatma Gandhi.* Boston 8: Beacon Press, Inc., 25 Beacon Street. 1958. 542 pp. $6.50. This is the first comprehensive biography of Gandhi by an Indian writer. Richly documented, it rescues the great leader from the goat's milk-and-loincloth school (the picture emphasized by the popular Western press during his lifetime) as well as from the equally false image of an inaccessible Divinity (an aspect in which he often appears in the minds of many Indians). Much of the material is new, and was not available to previous biographers. Here is the man Gandhi, seen for the first time through Asian eyes, and seen as a whole.

In addition, this study is a critique of Gandhi's philosophy. An analysis is made of his views on religion, sex, ethics, economics, the problem of communism, and the doctrine of nonviolence. The author shows how the events in Gandhi's life correlate with the evolution of his ideas. Further, the book is a fascinating history of India in the first half of the twentieth century—particularly of the Indian Freedom Movement which Gandhi led to success.

NEAL, H. E. *Six Against Crime.* New York 10: Julian Messner, Inc., 8 W. 40th Street. 1959. 192 pp. $3.50. The *Six Against Crime* are the six law-enforcement agencies of the Treasury Department. There is the Secret Service which protects the President and Vice President and suppresses counterfeiting and check forgery; the Bureau of Narcotics which fights dope dealers and the drug evil; the Bureau of Customs which combats smugglers; the Alcohol and Tabacco Tax Division, nemesis of the moonshiner, bootlegger, and gangland gunslinger; the Intelligence Division whose agents track down the tax cheats; and the U. S. Coast Guard which works closely with the others to spike smuggling, gun-running, and illicit drug rackets. In this true story about them, the author reveals the ingenious methods, the efficiency and bravery of the Treasury detectives in coping with the cunning of law evaders.

NEEDHAM, J. B. *Looking Up.* New York 16: G. P. Putnam's Sons, 210 Madison Avenue. 1959. 191 pp. $3.50. One of America's most famous polio victims, the author, as she says herself, was a rather frivolous person before polio entered her life. So it was that she sought to spoof friends, family, and other patients out of their gloom. Then later she went bravely on to make a home for her children, face her troubles with high good humor, and learn to live with the true spirit of religion.

NOURSE, A. E. *Scavengers in Space.* New York 18: David McKay Company, Inc., 119 West 40th Street. 1959. 188 pp. $2.75. But Tom and Greg Hunter cannot believe that their father's death was really an accident. Born

and raised in the twenty-second century mining colony at Sun Lake City on Mars, the brothers knew their father's skill as a mining engineer; they also knew that he had made dangerous enemies in the powerful Jupiter Equilateral mining combine that scoured the Asteroid Belt for lodes of rich metal. When they learn that their father had made a fabulously valuable discovery in the belt shortly before his death, the twins are determined to settle their own personal differences and go out to the asteroids as a team to search out the real reason behind their father's death.

O'DEA, W. T. *The Social History of Lighting.* New York 11: The Macmillan Company, 60 Fifth Avenue. 1958. 270 pp. $8.50. How was a billiards table lit in 1763, or the stage of the Red Bull playhouse in 1673? The earliest red and green traffic light was in London in 1868; but what was street lighting like in Paris in 1524, or San Jose, California, in 1885? How did the early U. S. settlers light their homes, and how did this compare with the homes of Sumeria 4,500 years ago, or with Stone-age lighting 15,000 years ago? How were 4,000 candles lit in less than a minute at the crowning of an English king, and what did Notre Dame look like with 1,600 fat candles burning at the funeral of a French one? How were early lighthouses lit, and how were they built? What light did they use in an operating room 2,500 years ago, and what were the rules for the surgeon who used it? How did Michael Angelo paint at night, and were paintings of night scenes accurate?

The answers to all these questions are to be found in this work, representing the fruits of careful historical research over many years in a virtually unexplored field. We read with horror of conditions in slave ships, warships, and emigrant ships because we no longer realize that to have no light was absolutely normal below decks; just as it was equally normal not to work after dark. The effect of light, or the lack of it, on social history should provide much food for thought. It is fortunate that the subject is also full of surprises and entertainment value for the general reader as well as for the historian. The author, in order to present effectively the numerous contemporary references upon which this study is based, made a series of tests involving lengthy vigils by the lights available in the past. The result is an authoritative work that will be invaluable professionally to historians, curators, and stage and screen producers.

O'ROURKE, FRANK. *The Far Mountains.* New York 16: William Morrow and Company, Inc., 425 Fourth Avenue. 1959. 474 pp. $4.95. This is the story of a young man coming of age in the rugged days of the early nineteenth century. He learned about the importance of family, the power of money, the agony of impossible love. He also learned how to be a mature man, how to hew a living from the untamed land around him, and how to attain the lasting loyalty from the Indian trappers and native shepherds who worked for him. Through Pelletier, he finally learned wisdom. It was at this time that the United States took over Texas and, shortly afterwards, invaded New Mexico. This is also a sweeping panorama of the turbulent years (1804-1848) in which the Southwest was the object of heated dispute and the seat of sporadic warfare.

OVERSTREET, HARRY, and BONARO. *What We Must Know About Communism.* New York 3: W. W. Norton and Company, Inc., 55 Fifth Avenue. 1958. 348 pp. $3.95. The authors have addressed this book to every intelligent American. They have looked at the subject of communism as it affects American life and have seen it as a force so powerful that no one of us can risk being in ignorance of it, or of only half understanding it. They see

communism—the theory, the party and the Soviet union—as a subject that demands study—not only by specialists, but also by all of us. For we are all having to respond to problems which communism creates in our world.

POTTER, M. A. *Mathematics To Use*, revised edition. Boston 17: Ginn and Company, Statler Building. 1959. 512 pp. $3.72. This text is designed for the large body of students who do not greatly profit by training in the traditional courses, but who need their mathematical abilities and understandings developed to help solve the problems they will meet in their everyday living and in the jobs they will probably have. This edition, while retaining the features that have proved to be successful in the previous editions, incorporates helpful suggestions of able teachers in various parts of the country, and includes additional modern business applications that the students are likely to need as adults.

Topics from the fields of arithmetic, algebra, and geometry are included. The topics chosen are keyed to the mathematics used in everyday activities, as people work, play, and spend their money. The development of topics in this book is in accordance with accepted principles of modern educational psychology. Additional help for the teacher is contained in a *Manual* written to accompany the text.

Really Living. Washington 12, D. C.: Narcotics Education, Inc. 1958. 191 pp. This book contains basic information for scientific education for the prevention of alcoholism and drug addiction reprinted from *Listen*, Journal for Better Living.

REEDER, COLONEL RED. *Attack at Fort Lookout*. New York 16: Duell, Sloan and Pearce, 124 E. 30th Street. 1959. 192 pp. $3. In this new book, the author of the famous West Point stories tells of the adventures of a young officer at a frontier outpost in the Old Northwest just before the War of 1812.

REINFELD, FRED. *How To Build a Coin Collection*. New York 16: Sterling Publishing Company, Inc., 419 Fourth Avenue. 1958. 128 pp. $2.50. The author explains how to trade with collectors and work with dealers, offers valuable tips on timing sales and purchases for greatest profit, and gives trade and specialists' secrets that will save the new collector years of trial and error. If you are just starting a coin collection, have just started one, or wish to launch a youngster or friend in your favorite hobby, you'll find this book a clear and simple introduction to coins and coin collecting.

Illustrated with over 400 coin photos, this book completely covers U. S. mintage; tells how to go about collecting U. S. coins by denomination, type, year, in proof or roll; and, most important, explains how to determine each coin's condition and value. Enlarged recognition photos of key coins in each U. S. series (arrows point to mint marks); a valuable list of "controller" coins; and an up-to-date analysis of coin values are helpful features. There is also information on collecting foreign and ancient coins and, as a guide to the collector, a sample collection of 500 foreign coins.

Rays—Visible and Invisible. New York 16: Sterling Publishing Company, Inc., 419 Fourth Avenue. 1959. 204 pp. $3.50. For a complete understanding of the intricacies of rays, including the many machines and devices which operate through radiation, the author uses a minimum of technical language and writes an exciting survey for the layman, with the spotlight focused on the many valuable uses to which radiation has recently been put, not forgetting atomic radiation, of course.

To understand why things work is just as important as to know how in the field of radiation—the light rays, sound waves, gamma rays, cosmic rays, x-rays, *etc.* That is the viewpoint which the author takes. The book's most important contribution is in making average readers familiar with the latest discoveries so that we can understand the effect they will have on our lives. Few people are aware of the swiftness with which our world is being changed daily by remarkable scientific advances.

RICH, JOSEPHINE. *Pioneer Surgeon—Dr. Ephraim McDowell.* New York 10: Julian Messner, Inc., 8 W. 40th Street. 1959. 192 pp. $2.95. On Christmas Day in 1809, Dr. Ephraim McDowell performed an operation that made medical history, since it was the first time that a surgeon dared to cut into the human abdominal cavity. A lynch mob raged outside with a rope to hang the "devil doctor," his wife stood at the door with a pistol and the operation continued. Those twenty-five fateful minutes changed the course of surgery.

SCHAKOVSKOY, PRINCESS ZINAIDA. *The Privilege Was Mine.* New York 16: G. P. Putnam's Sons, 210 Madison Avenue. 1959. 318 pp. $4. A unique, fascinating, and colorful report on Russia by one who was born a Princess, fled her country after the Revolution, and returned with diplomatic immunity forty years later.

SCROGIN, EVERETT, and WILLIAM BETTENCOURT. *Applied Drawing and Design.* Bloomington, Illinois: McKnight and McKnight Company, U. S. Route 66 at Towanda Avenue. 1959. 254 pp. (7¾″ x 10¼″) $4.60. This book gives basic technical information on each of the special fields of drawing: mechanical, woodworking, electrical, sheet metal, *etc.*, plus an understanding of tools and equipment. Allowance was made for the range of ability and interest found in the average class.

The 172 problems save the teacher's time and work, and yet do a thorough job of teaching correct procedures. The problems eliminate a lot of "routine" drawing and get right to the point. They focus attention on what is to be learned—and are not copy work. The material is tried and tested. This is the fourth edition, so the material has been used and improved upon by research and by suggestions from drawing instructors. The text contains 517 illustrations designed as "visual aids" in teaching procedures and the use of equipment by giving emphasis to the instructional material.

SEMEONOFF, A. H. *A New Russian Grammar*, new revised 12th edition. New York 10: E. P. Dutton and Company. 1959. 341 pp. $3.75. The author of this grammar is teacher of Russian in George Watson's Boys' College, Edinburgh. Arranged in a practical way and written throughout in the new orthography, it is intended to be a manual in reading, writing, and speaking Russian. The writer shows that the language is not nearly as difficult as it is reputed to be, and since the book is the result of many years' experience, its explanations have been thoroughly tested. Pronunciation is shown to be consistent, in accordance with a few simple rules. The initial difficulty of an unfamiliar alphabet is minimized by introducing the letters gradually over the first few lessons, so that the material given can be freely handled from the start. The same principle operates throughout, the parts of speech being treated in a progressive way so that an understanding of the language as a whole may be obtained at an early stage. A summary, however, is also provided, in which the whole grammar is given systematically, so that the student can at any stage refer to it and extend his knowledge in his own way. Further help in correct construction is given by the regular occurrence of special exercises, consisting of

Russian sentences and idiomatic expressions, together with English equivalents. Stress has been laid on the permutation of Russian vowels and consonants, based on the demands of euphony and constituting an important aid to the understanding of word-building, which is an essential and all-pervading element of the language.

SHERBURNE, ZOA. *Jennifer.* New York 16: William Morrow and Company, Inc., 425 Fourth Avenue. 1959. 192 pp. $2.95. "Why, it's a lovely house for a party!" Jennifer said, and her own words surprised her, for less than two months ago, when she and her parents had moved here to the state of Washington, nothing could have induced her to invite any of the high-school crowd into her house. And now she could actually give a party, with all the trimmings—even a jukebox for dancing. Mother was all right, she was in complete control of herself, she was more than that: she could help other people who were going through the same terrible battle she had fought and won. Jennifer had also won a victory over her own doubts about her mother. In her state of inner conflict, it had been hard to mingle with the girls and boys at school, but now she really belonged.

SNYDER, L. L. *The First Book of the Soviet Union.* New York 22: Franklin Watts, Inc., 575 Lexington Avenue. 1959. 96 pp. $1.95. This is a book about a country which has challenged the way of life of the free world. It is impossible to meet the challenge without understanding the challenger, Soviet Russia. In this book the author explains what communism is, how a communist society is run, and what it is like to live in such a society. He writes about education, art, science, medicine, law, industry, and politics in a land where "freedom" is meant only for those who do as they are told. Believing that it is not possible to understand the present without knowing the past, the author devotes part of his book to a description of Czarist Russia, the revolutionary movement, and the revolution itself. Here are the great dictators, Lenin and Stalin; the bloody purges; the secret police; the labor camps; the eternal censorship.

SPITTEL, RICHARD. *Savage Island.* New York 10: Criterion Books, Inc., 257 Fourth Avenue. 1959. 192 pp. $3.50. The sole survivor of a shipwreck on a deserted jungle coast, young Hans must learn the rules of survival, lest one small mis-step, one careless slip, bring him face to face with danger and death. Concentrating his keen powers of observation on the small creatures of the jungle, he soon learns what is safe to eat, where the water holes are, and how to hide himself out of harm's way during the lonely jungle nights. Slowly, in that first year, he makes friends among the animals—Bimbi, the amusing and affectionate little monkey; Dikhuid, the wounded elephant; and the beautiful white sambur stag whom he rescues from a leopard—and slowly, as he becomes more skillful, he ventures deeper into the jungle.

THOMPSON, R. W. *Battle for the Rhine.* New York 3: Ballantine Books, 101 Fifth Avenue. 1959. 205 pp. 50¢. The story of the savage bloody battle that smashed the Siegfried Line.

TRANTER, NIGEL. *The Stone.* New York 16: G. P. Putman's Sons, 210 Madison Avenue. 1958. 221 pp. $3.50. Certain experts and archaeologists have long held that the famed Stone of Destiny, now under electronic guard in the Coronation Chair at Westminister Abbey, is a 700-year-old fake, being merely a great lump of red sandstone quarried at Scone to deceive Edwart I, Hammer of the Scots, who stole it, while the true Scottish Coronation Stone was secretly buried somewhere in the Scone district of Perthshire.

In this humorous novel, an Oxford University research team decided that they had discovered where the genuine Stone was buried and sent an expedition to Scotland to dig it up, violent repercussions were bound to result, and sparks to fly. After the world-famous upheaval of several years ago, what might happen in Scotland—and in London—challenged the imagination. A young and impoverished Scots baronet decided to take a hand and, in partnership with a burly Glasgow ex-riveter and a local farmer's daughter, set out to ensure that this Stone should remain in Scotland at all costs.

TRAVIS, WILLIAM. *Beyond the Reefs.* New York 10: E. P. Dutton and Company, 300 Fourth Avenue. 1959. 221 pp. $3.95. Beyond the reefs of the Seychelles Islands in the Indian Ocean are waters which no man has ever penetrated, waters of unfathomed depths filled with blood-thirsty sharks which silently patrolled them. It was to these dangerous and uncharted waters that the author came in search of adventure. He tells of his remarkable experiences —one of the most exciting true stories ever recorded by a diver-writer.

TREECE, HENRY. *Perilous Pilgrimage.* New York 10: Criterion Books, Inc., 257 Fourth Avenue. 1959. 158 pp. $3.25. As Alys and Geoffrey de Villacours rode out in the warm spring sunlight of the year 1212, the violence of fuedal days seemed far from their peaceful corner of France. But the news brought that day by the battle-scarred Crusader stirred them both to dreams of high adventure. To the north a young shepherd, Stephen of Cloyes, was gathering a Children's Crusade to march on the Holy Land to free the Holy Sepulchre from the Saracens. Heralded by a fascinating and mysterious piper whose flute seemed to breathe the very magic of Araby, Stephen and the children's army stop to rest round the castle Beauregard. At dawn the next day the young Villacours steal out to join the long line marching to the sea.

VAN EVERY, DALE. *The Scarlet Feather.* New York 17: Henry Holt and Company, Inc., 383 Madison Avenue. 1959. 315 pp. $3.95. In the fall of the year, shortly after America's Revolutionary War, the Jordan family, Virginia gentry, with their servants and artisans, traveled down the sluggish Ohio River to lay claim to a strip of land on the north bank above Louisville. What they faced was more than a wilderness challenge, for the savage frontier was to invoke its own strange laws of survival. And a scarlet feather, once the talisman of an Indian girl, was to symbolize the final break with tradition.

WADHAM, RUTH. *Week-End in Baghdad.* New York 11: The Macmillan Company, 60 Fifth Avenue. 1959. 200 pp. $3.25. A high-ranking British diplomat had been killed in Baghdad. There were almost no clues, for someone had cleverly used a traditional Iraqi funeral to mask the murder. Mahmud al Wakil, a young Iraqi student, was accused of the crime—and a net of circumstantial evidence began to tighten about him.

WALTERS, HUGH. *Menace from the Moon.* New York 10: Criterion Books, Inc., 257 Fourth Avenue. 1959. 191 pp. $3.50. When the atomic-energy plants on which the world's supply of electricity depends becomes too "hot" to operate, scientists from the United States, Britain, and Russia work frantically together to save Earth from the deadly radiation emanating from mysterious domes on the moon. Their only workable plan requires a manned rocket flight to outer space to place a beacon on the moon's surface so that atomic warheads can be directed to wipe out the forces which are slowly crippling Earth and all life on it.

Young Chris Godfrey can give only one answer when his old friend, Sir George Benson, outlines the seriousness of the problem. He plunges into the

tests which will lead him again to the great launching station at Woomera. Working with Sir George, Wing Commander Greatrex, and Bill Gillanders, Chris is prepared in every way for the ordeal to come. But neither Chris nor his friends know that Sir Leo Frayling, the brilliant scientist in charge of the operation, has faced the age-old dilemma—to sacrifice one life for many—and made his choice.

WEINGAST, D. E. *This Is Communism*. New York 3: Oxford Book Company, 71 Fifth Avenue. 1959. 190 pp. This book becomes available at a crucial hour in our nation's history. It casts a new light on the subject of communism. The author's background of teaching and study has equipped him for the task of writing.

WELCHONS, A. M.; W. R. KRICKENBERGER; and H. R. PEARSON. *Solid Geometry*. Boston 17: Ginn and Company, Statler Building. 1959. 348 pp. $3.48. This text is a revision of the Welchons-Krickenberger: *New Solid Geometry*. The general plan and sequence of topics have remained much the same though changes have been made to bring the book in line with the latest thinking on the teaching of solid geometry. Color has been used to help students to visualize points, lines, and planes in space. The organization of the chapter on prisms and cylinders has been simplified. The role of approximate number in solid geometry has been discussed and problems which provide practice in approximate computation have been included. Students have been provided with help in seeing how proofs can be developed through use of converses, inverses, and contrapositives of theorems.

The arrangement of subject matter provides a logical development that is adaptable to various courses of study. Those schools that are now placing emphasis upon the solving of many original problems, rather than upon demonstration of theorems and corollaries, will find ample problem materials. Those schools that prefer to stress the logical structure of solid geometry will find a well-organized sequence of logical thinking and much help for students in reasoning logically. Having met the needs of these differing philosophies on present-day solid-geometry teaching, the book, of course, provides material for those schools that wish to steer a middle course by dividing attention between the logical structure of solid geometry and the solving of original problems.

Where advantageous, the exercises are arranged in two groups, Group A and Group B. Group A contains the exercises for all members of the class, and Group B contains exercises which offer a greater challenge. A minimum course consists of the proofs of the theorems and corollaries marked with two stars, an informal treatment of the theorems and corollaries marked with one star, and some of the exercises in Group A. A medium course included the proofs of all starred theorems and corollaries, and some exercises in Groups A and B. A maximum course includes the proofs of additional theorems and corollaries and some exercises in Groups A and B. No student can be expected to do all the exercises in one semester.

WOODBURY, D. O. *1001 Questions Answered About the New Science*. New York 16: Dodd, Mead and Company, 432 Fourth Avenue. 1959. 374 pp. plus 16 pp. of halftones. $6. In the last decade, a new science has recreated the world about us, has revolutionized our way of life, and has vastly altered even our manner of thinking. In these pages, the author, by the question-and-answer method, discusses the dawning age of space; the era of fission and fusion; the drastic changes in engineering technology—mechanical, electrical, chemical, civil, mining, architectural, etc.; the development of automation; the

great voyage of exploration in physics; the modern genie of electronics; the new alchemy of chemistry; the quest for the secret of life, through chemistry and biology; the story of minerals; and mathematics, the bedrock of science. The book thus becomes an orientation of our science world today and tomorrow. It is written in question-and-answer form for quick reference and is illustrated in line and halftone. An index assures ready access to the wide range of contents.

YAGER, ROSEMARY. *The Four Bronze Horses.* Caldwell, Idaho: The Caxton Printers, Ltd. 1959. 224 pp. $4. Filled with excited anticipation, a Spartan boy named Creon arrived in Corinth on the eve of 121st Olympiad, in 296 B. C. Crowds were coming from many lands to see the spectacle of the Games, but Creon had a personal interest in the Olympiad that year. His father, Pisidorus, a famous charioteer, was taking part in the chariot-racing event. When the time for the race drew near, thirty chariots were driven onto the field. Twelve laps of the mile-long circuit had to be covered in the race, and Creon watched with mounting excitement as the grueling contest began. By the end of the eleventh lap, only two of the starting charioteers remained, and one of these was Creon's father, who was finally the winner.

ZAIMOVSKY, S. G. (compiler), and A. V. LITVINOVA (editor). *Russian-English, English-Russian Pocket Dictionary,* fourth-edition. New York 10: E. P. Dutton and Company, 300 Fourth Avenue. 1958. 431 pp. (3″ x 5″). $1.95. This dictionary, of 17,000 words, is organized along language family lines. Words are listed in strictly alphabetical order. The part of the lead word of a family group that is repeated in all derivatives is separated from the word-ending by two parallel vertical lines. Within each word family group, the lead word is indicated by a tilde. In each case of a change of word-ending, the tilde substitutes for the part of the word seperated from the ending by the two parallel lines.

Homonyms are presented in separate family groups and are so designated by Roman numerals. The various meanings of a word are indicated by Arabic numerals in parentheses and different parts of speech, by Arabic numerals followed by a period. All explanations of the separate meanings of a word are given in italics in parentheses.

Synonyms in translation are separated by commas, meanings further apart are separated by semi-colons. Phrases and idioms are included in this dictionary only to a most limited degree. In the Anglo-Russian section the pronunciation of each word is indicated by phonetic transcription in the symbols used by the International Phonetic System. The accent is indicated for all Russian words except for monosyllabic words. In the Russian-English section the accent is also shown for all English words except for the monosyllabic words. Words, parts of words or expressions shown in parentheses are not considered obligatory. Variations of an expression and the translations of an expression are also indicated in parentheses.

ZELOMEK, A. W. *A Changing America.* New York 16: John Wiley and Sons, Inc., 440 Fourth Avenue. 1959. 191 pp. $3.95. This book brings together the important subjects of contemporary life that are ordinarily treated as separate and distinct—suburbia, service, leisure, automation, modern man, modern women, and culture. The author interprets these subjects and shows how they are really interrelated, how they influence each other, and how they directly affect the daily life of every American.

Pamphlets for Pupil-Teacher Use

Annual Report. New York 17, N. Y.: Carnegie Corporation of New York, 589 Fifth Avenue. 1958. 105 pp. The educational foundation's annual report. It reveals that grants of more than $7 million were made during the past fiscal year, which ended September 30, for educational purposes in the United States and certain British Commonwealth areas.

BONAVENTURE, SISTER M. *Successful Devices in Teaching Latin.* Portland, Maine: J. Weston Walch, Box 1075. 1959. 205 pp., (8½" x 11"), offset printed, generously illustrated, heavy paper bound. $2.50. This is not a textbook, nor is it a course of study—it is a collection of devices, techniques, and supplementary class materials that have proved valuable over a period of years. It is a high-school level teaching manual, and is prepared for public high-school use, as well as for private schools. There are included suggestions for many conceivable phases of Latin instruction. In addition, there are 40 pages of songs, skits, and playlets for enlivening and enriching the Latin classroom! With this manual, Latin need not be a "dead" language, but can be alive and forceful in competition with French, Spanish, English, the social sciences, and other studies in the modern curriculum.

BRANDES, L. G. *Science Can Be Fun.* Portland, Maine: J. Weston Walch, Box 1075. 1958. 243 pp. (8½" x 11") offset printed. $2.50; $2 each for 10 or more copies. Here is a book that makes science interesting to students in the 7th, 8th, and 9th grades. The book contains scientific experiments, puzzles, tricks, games, stories, problems, oddities, and optical illusions. There are collections of materials designed to excite students about biology, about physics, and about chemistry. There is something here for every level of ability from the slow learner to the very brilliant student.

CARLSON, T. E., and C. P. WILLIAMS. *Guide to the National Defense Education Act of 1958.* Washington 25, D. C.: Superintendent of Documents. 1959. 36 pp. 30¢. Discusses the 10 titles with the view to help schools in their participation in the Act.

Catskill Area Project in Small School Design. Oneonta, New York: State University Teachers College, 215 Home Economics. 1957. 24 pp. 50¢. Several experimental projects currently are underway to help find solutions to the problems of the small school. This describes one approach. Not a substitute for reorganization, it is an attempt to discover a way of improving the quality of instruction in small high schools by making the most of the advantages of smallness. This bulletin is a preliminary report of an experimental study.

COMMITTEE ON TAX EDUCATION AND SCHOOL FINANCE. *Citizens Speak Out on School Costs.* Washington 6, D. C.: National Education Association, 1201 Sixteenth Street. 1959. 64 pp. 50¢. Discounts: 2-9 copies, 10%; and 10 or more copies, 20%. Discusses the questions of the importance of education, the adequacy of money for its support, the cost of the education we need, and can we afford the education we need. Includes four fundamental conclusions.

The Cost of Conscription. Washington 2, D. C.: National Council Against Conscription, 104 C Street, N. E. 1959. 12 pp. 15¢. A critical review of the Universal Military Training and Service Act.

CUMMINGS, H. H., and H. K. MacKINTOSH. *Curriculum Responsibilities of State Department of Education.* Washington 25, D. C.: Superintendent

of Documents. 1958. 82 pp. 55¢. The results of a questionnaire sent in 1955 to the 48 states, the 4 territories, and Puerto Rico.

Curriculum Study, 1957-1958. Salisbury, North Carolina: North Rowan High School, Rowan County Schools. 140 pp. Mimeograph. This handbook represents a brief summary of the North Rowan Curriculum Study.

DAVID, OPAL D. *The Education of Women—Signs for the Future.* Washington 6, D. C.: American Council on Education, 1785 Massachusetts Avenue, N. W. 1959. 168 pp. $2. The proceedings of a conference for the purpose of considering the status of research on the education of women, of reviewing recent progress, and of stimulating new research in women's education.

DEIGHTON, L. C. *Vocabulary Development in the Classroom.* New York: Bureau of Publications, Teachers College, Columbia University. 1959. 72 pp. $1.25. This study is addressed to all teachers, at whatever level, who are concerned with the meanings of English words. While the emphasis falls upon development of vocabulary, the underlying purpose is to throw light upon some of the basic facts about how our language operates.

Financing Council Schools, 1958-59. New York 27: Metropolitan School Study Council, 525 West 120th Street. 1959. 88 pp. plus 40 tables. $2. This is the report of the twelfth study of how member communities of the Metropolitan School Study Council support public education. It is a constant reference for administrators and school boards in Council communities in making up annual budgets. All over the nation, persons concerned with education have come to rely on the data in this publication as a basis for making comparisons and judgments in assessing school expenditures. It gives facts on inflationary changes in our economy and Council schools' efforts toward keeping in step, how much money Council schools spend per pupil, where the money comes from, ranges in staff salaries and salary policy, staff size, how many staff members per thousand pupils, how many guidance counselors, how many psychologists, and how many specialists of various kinds.

The Ford Foundation Annual Report. New York 22: The Ford Foundation, 477 Madison Avenue. 1958. 184 pp. Contains an article on "The World Imbalance in Education" by Henry T. Heald and reviews 13 studies for which the Foundation has made grants. Also included are: financial statements, a listing of the 179 Foreign Area Training Fellowships, and an index of grant recipients.

Granting Credit for Service School Training. Washington 6, D. C.: Commission on Accreditation of Service Experiences of the American Council on Education, 1785 Massachusetts Avenue, N. W. 1959. 16 pp. This Bulletin has been prepared to assist accrediting officials in granting credit for service school training by furnishing information about the evaluation of educational experiences gained through such training.

GUITARD, LUCIEN, and LEON MARANDET. *French Phonetics Illustrated.* New York 22: Cambridge University Press, 32 East 57th Street. 1959. 64 pp. 75¢. This book is primarily for the first and second years of French. Sound is associated with particular objects. Here the teacher will find it helpful to use these key words with key pictures for the different sounds.

HERLIKY, L. B., and JOEL WILLIAMS. *Current Expenditures Per Pupil in Public School Systems: Small and Medium-Sized Cities, 1956-57.* Washington 25, D. C.: Superintendent of Documents. 1958. 44 pp. 25¢. Presents data for the elementary and the secondary full-time day public schools

in urban places with population between 2500 and 25,000. Bulletin Number 537 presents data for system of more than 25,000.

Improve Your Teaching with Books. New York 18: American Book Publisher Council, 24 West 40th Street. 1959. 8 pp. Free. A discussion of that part of the National Defense Education Act of 1958 that relates to this area and suggestion of procedures in obtaining instructional aids under the Act.

KARNER, E. F., and C. M. CORDELL. *Successful School Publications.* Portland, Maine: J. Weston Walch, Publisher, Box 1075. 1959. 215 pp. (8½" x 11") $2.50. This offset-printed, paper-bound book is a practical aid to anyone who deals with the production of school publications. It is designed to help the teacher who has become the sponsor of the school newspaper or yearbook. Here are aids and ideas to help not only the new adviser, but also that person who has been in this field for a number of years. There are specific guides for every step in production. Here are illustrations and many examples of good journalism practices, including pages from school papers and yearbooks, headlines, columns, feature stories, sport stories, advertisements, pictures, *etc.* The book is divided into four parts—Part I, The School Newspaper—Fundamentals; Part II, The School Newspaper—Further Ideas; Part III, The School Yearbook; and Part IV, The School Magazine.

Kellogg Foundation Annual Report. Battle Creek, Michigan: W. K. Kellogg Foundation. 1958. 201 pp. Reviews its grants to Europe, agriculture, medicine and public health, hospitals, nursing, dentistry, and education; presents reports of the secretary and the treasurer, and lists the 137 Fellowship grants in 23 foreign countries and the personnel of the Foundation.

KIRK, C. F. *Successful Devices in Teaching Spanish.* Portland, Maine: J. Weston Walch, Publisher, Box 1075. 1958. 183 pp., (8½" x 11") $2.50. This new manual, offset printed, is prepared especially for the beginning teacher of Spanish in secondary schools and for the more experienced teacher who seeks help in the form of fresh ideas and techniques. The author presents a wide variety of teaching techniques obtained from over 200 teachers in 31 states. In addition, there are quotations, digests, and adaptations of suggestions from various professional publications. All devices have proved effective in actual classroom practice. The book covers a wide range of topics, from general classroom procedures to the teaching of specific points of grammar.

The Lincoln Ideals. Washington, D. C.: The Lincoln Sesquicentennial Commission. 1959. 53 pp. A topical approach has been made in the preparation of the booklet. In it one finds quotations from Lincoln which reflect his personality and principles. These quotations are classified under eight broad subjects, each illustrative of his thought and actions.

LOMAS, P. S. *A Survey of Business Education in the Secondary Schools of California.* Sacramento: Superintendent of Public Instruction, State Department of Education. 1958 (December) 56 pp. A survey of the adequacy and effectiveness of business programs being offered by California junior and senior high schools and colleges.

MELLENBRUCH, JULIA. *The Tape Recorder in the Classroom.* 1959. 72 pp. $2. Describing the many basic ways in which the tape recorder can be used in teaching, this handbook is the eighth in a series of publications prepared by the Visual Instruction Bureau to emphasize ways of using resource materials as Bridges for Ideas. The primary purpose of the booklet is to acquaint the teacher with the use of the tape recorder in the classroom. In addition, it

outlines provisions for care and operation of equipment and storage of materials, equipment, and accessories; describes the criteria for selecting a tape recorder; and lists sources of materials, equipment, and accessories. The next handbook, *Educational Displays and Exhibits*, has recently been released.

MUNSE, A. R.; and E. D. BOOHER. *Federal Funds for Education.* Washington 25, D. C.: Superintendent of Documents. 1959. 218 pp. 75¢. Identifies programs and reports amounts of Federal funds expected for education and from programs financed in educational institutions either in whole or in part through Federal funds for 1956-57 and in 1957-58. In addition to tabulations of amounts provided, brief descriptions of the Federal activities in education are given.

1959 Catalog of Standardized Tests and Evaluation Materials. Los Angeles 28: California Test Bureau, 5916 Hollywood Blvd.; 206 Bridge Street, New Cumberland, Pa.; 110 South Dickinson Street, Madison Wis.; or 2124 Irving Blvd., Dallas 7, Texas. 112 pp. Free. A testing and description of tests available through the Bureau.

Occupational Information for Counselors. Washington 25, D. C.: Superintendent of Documents. 1958. 32 pp. 15¢. An annotated bibliography showing that the number and variety of ways to earn a living have been multiplied a thousandfold since the turn of this century.

Preparing Students for College. Chicago 10: Science Research Associates, 57 West Grand Avenue. 1959. 83 pp. $1.50. This book contains case histories of programs in high schools in Pittsburgh, Pa.; Evanston, Ill.; LaGrange, Ill.; Baldwin, N. Y.; Scarsdale, N. Y.; and New York City, which parents, principals, teachers, and school board members will want to study. Here are fundamentals to be followed in the search for wise counseling. Here are suggestions for the early identification and motivation of talented students and a helpful guide to the education of all children. Here also are the essential pitfalls facing college-bound students which parents and teachers should know about. Because nearly 50 per cent of the students who enter college either fail, drop out, or transfer along the way, parents and teachers should know about the unrealistic picture some students have of college, the dangers of the immaturity and family dependence, the perils of poor academic preparation, and the hazards of faulty study habits.

PRESCOTT, HERBERT, editor. *Oral English Can Be Fun!* Portland, Maine: J. Weston Walch, Publisher, Box 1975. 1958. 240 pp. (8½" x 11"). Heavy paperbound. $2.50. This book contains many tested games and activities in speech that are fun, thought provoking, purposeful. Here are aids for the pupil who doesn't think he has anything to talk about, who can't think on his feet, and who doesn't think creatively. Sixty-one leading teachers have contributed their best ideas for making the oral English class both meaningful and attractive to secondary-school students. As one of them wrote, "Fear is the main barrier to becoming an effective public speaker. Speech must be made fun for the students. This eliminates much of the fear."

Progress, 58. Washington 25, D. C. Department of the Army. Office of the Chief of Information. 1959. 48 pp. Free. Text and pictures of the army's readiness to meet the challenge of tomorrow.

Projections of the School-Age Population, 1959-63. Washington 6, D. C.: National Education Association, 1201 Sixteenth Street, N. W. 1959. 8 pp. Some timely projections of the school-age population, by states, for the five

years beginning with 1959. These figures are being released as a supplement to Research Report 1958-R6, *Estimates of School Statistics*.

RANSOM, W. R. *Algebra Can Be Fun*. Portland, Maine: J. Weston Walch, Publisher, Box 1075. 1958. 200 pp. (8½" x 11") Offset printed. $2.50; $2 each in lots of 10 or more copies. In this book, there are ideas to excite all kinds of minds, and all levels of ability. They range from a discussion of the absurd: "One cat has one tail; No cat has two tails; Therefore, one cat has three tails"; to a twenty-four term formula connecting any 24 numbers. There are 200 pages of amazing algebraic mysteries and applications and 189 different types of challenging problems. This book is not filled with the ordinary computations and problems of the usual high-school algebra. Rather it is a supplementary book, the "dessert after the main course." It leads students on to greater understanding and a wider appreciation.

———. *Calculus Quickly*. Portland, Maine: J. Weston Walch, Publisher, Box 1075. 1958. 60 pp. $1. Many school teachers who are anxious to send their well-prepared students to college with some knowledge of the calculus find the available books too complete for convenience. This small book, which requires only a part of a term, gives enough to permit the entrance into first courses in college physics, engineering, economic, and physical chemistry. Its principal omissions are partial differentiation, multiple integration, and infinite series. The use of tables of integrals, the toilsome and unrewarding methods of partial fractions, substitutions, and rationalization are avoided. A very complete index is provided, and the table of integrals is fortified by numerical tables to facilitate the evaluation of the integrals.

———. *Rapid Analytics*. Portland, Maine: J. Weston Walch, Publisher, Box 1075. 1958. 60 pp. $1. This book is designed for popular use, as a textbook for the senior year of high school, or for self-study by any who need to understand the diagrams accompanied by algebraic work found in books on physics, engineering, economics, *etc*. It differs from books on analytical geometry not only in being very much shorter, but also in choosing its contents strickly from the point of view of practical value. The exercises are only enough in number to insure that the topics are understood. They are simple algebraically and numerically, so that they illustrate the theory without raising side issues. No attempt is made to provide for exceptional or abnormal cases. A very complete index is provided, and there is a table of logarithms to the base e. This brief treatise will be found interesting to the general reader, and valuable to those engaged in scientific or engineering pursuits, who may not have the time for longer works, but need enough knowledge to enable them to use books or periodicals in which such knowledge is assumed.

A Report to the California Legislature on the Study of Public School Support. Sacramento: Superintendent of Public Instruction, State Department of Education. 1959. 24 pp. A report on important factors in public school support, operation of state support, administration of support, recommendation, *etc*.—an 8-part report.

SALISBURY, GORDON, and ROBERT SHERIDAN. *Catalog of Free Teaching Aids*, second edition. 1959. 180 pp. $1.50. This book, containing items for primary grades through junior college, has been compiled by educators who have evaluated all the aids. Listed are over 5,000 audio-visual items which pertain to the curriculum at all levels of schools. Every item is free; there are no "inexpensive" aids or films included. The catalog lists the titles of booklets,

charts, maps, free filmstrips, posters and teaching kits. The reading grade levels and the addresses where these aids may be obtained are included.

SANTIAGO, F. M., compiler. *Inexpensive or Free Materials Useful for Teaching Speech.* Ann Arbor, Michigan: Braun-Brumfield, Inc., P. O. Box 203. 1958. 142 pp. $1.85 per copy; 5 or more copies, $1.55 each. This is an annotated list of teaching aids for prospective speech and English teachers building materials files in methods and materials courses; beginning or experienced speech and English teachers interested in going beyond the textbook instruction; and education departments of college, university, and public libraries. It contains more than 500 entries.

SCHLASS, SAMUEL, and CAROL J. HOBSON. *Fall 1958 Statistics on Enrollment, Teachers, and Schoolhousing.* Washington 25, D. C.: Superintendent of Documents. 1959. 24 pp. 20¢. Presents the fifth annual fall survey of enrollment, teachers, classrooms in full-time public elementary and secondary day schools in the United States.

STEPHANETTA, SISTER M. *Biology Can Be Fun.* Portland, Maine: J. Weston Walch, Publisher, Box 1075. 1958. $2.50. This is a recreational activity applied to biology and perfected with several years of experimentation in the classes of St. Joseph High School in Chicago. There are three parts. *Zoolo* covers 75 essential facts about animal life. Classification of animals, structure, physiology and disease carriers form the basis for these facts. *Herbo* covers the important fundamentals of classification of plants, structure, physiology, and heredity. And *Manno*, as its name indicates, includes the basics on the physiology and anatomy of man.

This collection consists of enough equipment for a class of 35 students to play each of these three instructional games. There are, in each instance, simple directions for playing, 75 clearly stated fact slips for the teacher, a teacher's checking card, and playing cards for the group. (The cards are printed in pairs on tough card stock and will be usable for a long time). This collection of game material is stapled with a single staple simply to keep the unit in good order for delivery.

STUART, W. P., editor. *Kentucky's Resources—Their Development and Use.* Lexington: University of Kentucky, Bureau of School Service. 1958 (December) 347 pp. Provides information on Kentucky's resources and the part they have played in the development of the economic and cultural life of the state. Major topics covered are: soil, water, forests, wildlife, parks and recreation areas, native flowers, trees and shrubs, minerals, and human resources.

TURNEY, BILLY. *Geometry Teaching Aids You Can Make.* Portland, Maine: J. Weston Walch, Publisher, Box 1075. 1958. 176 pp., (8½" x 11") offset printed. $2.50. Here, collected in a single book, are 160 different teaching devices the teacher or his students can construct to improve understanding of geometric principles. Some of these have been previously published in sources such as the *Mathematics Teacher*, but dozens of them are previously unpublished. With each aid or device, there is a detailed drawing, complete construction details, and a full discussion of its uses and possible drawbacks. Each of these devices was evaluated before publication. Here is a book which will help even the slower geometry students to a much more adequate understanding of this abstract subject.

25th Annual Meeting—Florida Association of Colleges and Universities. Temple Terrace: C. D. Hamilton, Florida Christian College. 1959. 84 pp.

Proceedings of the 25th annual meeting of the Florida Association of Colleges and Universities discussing articulation between their schools and colleges in the subject area field of biology, chemistry, and physics.

United States Air Force Occupational Handbook. Washington 25, D. C.: Headquarters U. S. Air Force. 1958 (Feb.). 192 pp. (8½" x 11"). A manual for vocational guidance counselors and Air Force personnel officers. The main body of this book describes the duties performed in each of the 42 Air Force career fields, suggests educational preparation that can be of value, and explains what training the Air Force itself provides. Other sections contain information on pay and allowances, requirements for enlistments, opportunities for advancement, training leading to a commission, classification procedures, women in the Air Force (WAF), *etc.*

WAGNER, R. F. *Successful Devices in Teaching German.* Portland, Maine: J. Weston Walch, Publisher, Box 1075. 1959. 200 pp. (8½" x 11") offset printed, paper-bound. $2.50. For German language teachers and those interested in the general psychology of language instruction, this book is a collection of sound, and sometimes unique, approaches to the teaching of German. Most of the devices and techniques described are equally usable in the teaching of any other language. The manual is organized so that information can be found readily.

WRIGHT, W. W., and C. W. JUNG. *Why Capable High-School Students Do Not Continue Their Schooling.* Blooming: Indiana University Bookstore. 1959 (January). 88 pp. $1. A study of the upper 10% of the 1955 high-school graduate in the state of Indiana to discover the reasons why many do not continue their education.

Your Gifted Child. Washington 25, D. C.: Superintendent of Documents. 1959. 40 pp. 20¢. Reflects the belief of the Children's Bureau that long-range planning for gifted children should begin early in their formative years. While written for parents, it is expected to be useful also to members of the professions serving children.

Books Received Too Late for Classification

The American Economy: An Appraisal of its Social Goals and the Impact of Science and Technology. New York 36: Joint Council on Economic Education, 2 West 46th Street. 1959. 168 pp. $2. A unique collection of papers demonstrating the close relationship of the sciences and the social studies, especially economics, this book opens with discussions of the major goals of the American economy; *i.e.*, economic growth, stability, security, freedom, and justice. Each goal is the subject of a paper by an eminent economist. There follows a series of authoritative discussions of up-to-the-minute scientific and technological developments in the fields of energy, health, automation, space exploration, and food by noted experts. An evaluation by leading economists of the economic implications of these developments follows each scientific presentation.

All these addresses were prepared for and delivered at the special three-week program on "The Impact of Contemporary Scientific and Technological Developments on the American Economy" held last summer for selected science and social studies teachers from 33 schools. The program was sponsored by the joint Council on Economic Education in cooperation with the National Science Teachers Association and the National Council for the Social Studies. The

booklet contains an appendix listing the speakers, workshop participants, members of the staff, and the more than 100 organizations which contributed materials for the project. A companion volume of teaching units incorporating the knowledge gained through the project, prepared and classroom tested by the participating science and social studies teachers, will be published next year.

AUPHAN, REAR ADMIRAL, and JACQUES NORDAI. *The French Navy in World War II.* Annapolis, Maryland: United States Naval Institute. 1959. 413 pp. $6. The French Navy's story during World War II is given here in a comprehensive account. "No matter what course they took, or whether or not we agreed with them," says Admiral H. Kent Hewitt, U. S. N., in his introduction, "I feel that the majority of French naval officers and men must be given credit for pursuing what they felt was their duty. It is hard to put oneself in their shoes. In my opinion, the schisms and divergences of opinion produced in France by the unfortunate events of the last war not only continue but also have much to do with the difficult position in which France now finds herself." This book is a factual now-it-can-be-told book. Its authors not only describe the operations and engagements of French naval units in continental France, Norway, Africa, and Indo-China; but also disclose the many involved internal and international political maneuvers that took place in Vichy. That France was able to survive at all is a wonder. That it preserved its unity so as to return to fight and participate in the final victory is a tribute to morale, discipline, and traditions that date back to the crusades. This book is the latest of its series portraying the naval history of World War II as seen from the viewpoint of prominent officers—enemy as well as allied—who fought in that war.

Best Books for Children. New York 36: R. R. Bowker Company, 62 West 45th Street. 1959. 190 pp. $2 each net postpaid; 40% off on 5 or more copies. This catalog includes 2700 books on fact and fancy, science and social studies, nature and know-how, religion, biography, history, art, sports, careers, *etc.* Everything to interest every young reader—ranging from the pre-schooler through the 9th grader. Librarians, educators, and parents alike will find this new booklist a valuable guide in selecting from among the thousands of available children's books.

BUTLER, K. B., and G. C. LIKENESS. *A Practical Handbook on Display Typefaces.* Mendota, Ill.: The Butler Typo-Design Research Center. 1959. 176 pp. Cloth-bound, $5; paper-bound, $7.50. This is the sixth in a series of practical handbooks on publication layout. Other titles, each on publication layout, in the series are: *Effective Illustration, Headline Design, 101 Usable Publication Layouts, Double-Spreads,* and *Ken Butler's Layout Scrapbook.* Here is an excellent series of handbooks for high-school sponsors of Yearbooks, newspapers, *etc.* Here the authors examine the faces available to today's printer, typographer, layout person, and art director and suggest how these faces may be used to make publication and advertising layout more vivid, and more compelling. Each face is examined in terms of what it can do. With such an evaluation, functional usages often emerge for faces which many may greatly dislike. There are over 1500 specimens of display type faces.

Careers Ahead for College Women. Boston 15: Registrar, Simmons College, 300 The Fenway. 1959. 86 pp. $1.50. In 1946 Simmons College began publishing a series of vocational guidance bulletins, each presenting a specific area of employment open to college women after graduation. These bulletins undertook not only to describe a variety of occupations, but also to

answer the questions a high-school girl might naturally ask: What personal qualities are needed for success in this field? What are the beginning opportunities? What are the opportunities for advancement? What courses should I take in high school and college to prepare for this work? The college has therefore decided to issue this one-volume collection of reprints—in some instances slightly edited to bring them up to date—in the hope that it will prove a useful addition to the libraries of persons engaged in counseling girls of pre-college age.

Careers in Science Teaching. Washington 6, D. C.: National Science Teachers Association, 1201 Sixteenth St., N. W. 1959. 16 pp. Single copy, free; additional copies, 10¢. Discusses the work of a teacher, job opportunities, remuneration, what it takes to be a science teacher, choosing a college, advantages; also presents sources of information. Also available from the same source (single copy, free; additional copies, 15¢) is a 24 page pamphlet, *Action for Science under NDEA,* which reports an association conference on the National Defense Education Act of 1958.

CLYMER, ELEANOR, and LILLIAN ERLICH. *Modern American Career Women.* New York 16: Dodd, Mead and Co., 432 Fourth Ave. 1959. 192 pp. $3. The eighteen biographical sketches in this volume illustrate vividly the variety of careers in which women have distinguished themselves in this country.

COLLINS, W. B. *The Perpetual Forest.* Philadelphia 5: J. B. Lippincott Company, E. Washington Square. 1959. 288 pp. $4.50. Today man is destroying the closed forest that is doomed to extinction perhaps within this century. The author tells of the hidden wonders of the forest: the nesting-place of a rare bird; the miracle of science by which light is transformed into life; the relentless armies of the driver ants and Ponerines that wage incessant war against the termites and all other living creatures. He penetrates the strange world of the termites, architects in darkness endlessly building their carefully organized cities under the earth, whose civilization has been compared favorable to that of the bees or the ants or even of man. He is impressed by the ingenious camouflage of the treeviper, coiled like a green climber stem, and by the courage of the honey badger, who will fearlessly attack any enemy.

COMMITTEE ON TAX EDUCATION AND SCHOOL FINANCE. *Does Better Education Cost More?* Washington 6, D. C.: National Education Association, 1201 16th St., N. W. 1959. 45 pp. 50¢ single copy; discounts: 2-9 copies, 10%; 10 or more copies, 20%. Money may not be everything when it comes to producing better schools, but, of all the factors which influence quality in education, it is the most powerful. This is the conclusion drawn from a study undertaken recently by the Committee on Tax Education and School Finance of the National Education Association. The study seeks to replace hearsay and guesswork surrounding the relationship of cost to quality in education with research findings. The big question facing school boards, state legislatures, and even the United States Congress as they debate how much money to spend for education, is this: Does more money actually mean better schools? This NEA study reports: "A good educational program is not guaranteed by high expenditure alone any more than a good crop of corn is guaranteed by adequate rainfall alone. But good education is no more likely to occur under poor expenditure conditions than a good crop of corn under inadequate moisture conditions, regardless of the other desirable factors. . . . All other things being equal, more money buys better education."

COOPER, H. P. *Minneapolis: Its People, History, Resources, and Government.* Minneapolis 13: Minneapolis Public Schools, 807 Northeast Broadway. 1959. 137 pp. $2. This piece of work has been done to fill a need for supplementary material, not otherwise available, for use in grade 9 social studies classes in the Minneapolis Public Schools.

DAHL, BORGHILD. *Stowaway to America.* New York 10: E. P. Dutton and Company, 300 Fourth Avenue. 1959. 192 pp. $3. When the idea of escape first occurred to Margit, she rejected it as fantastic. How could an orphan hope to leave the life of rigid discipline and drudgery in Norway, much less go to America to join Cleng Peerson, the one person she idolized? But the idea grew and a plan took shape in Margit's mind, leading her to risk the dangers of becoming a stowaway aboard the *Restoration*, on its hazardous voyage across the Atlantic in 1825.

DAILEY, VIRGINIA. *The Honor of Lawrence House.* New York 16: Duell, Sloan and Pearce, 300 Fourth Avenue. 1959. 189 pp. $3. When she entered Waverly College at mid-term, Rosemary Rossiter knew that she was starting under a handicap. On the other hand, she was lucky enough to find herself living at Lawrence House. This was both an honor and a challenge, for the Lawrence girls had the well-earned reputation of being leaders in academic work and in other activities.

Rosemary soon found friends at Lawrence House, but she encountered problems, too. There were worries and disappointments such as everyone entering college is bound to meet, but a serious involvement in the house theft of jewelry cast a very dark shadow over her life. This happened just at a time when she was beginning to feel more secure, happy with her classmates, enjoying her first dates, and interested in her studies, even to the point of discovering a possible career in the work of the speech clinic. Fortunately the gloom is dispelled when the mystery of the thefts is cleared up, though Rosemary risked her own future to restore the honor of Lawrence House.

DEUTSCH, H. C. *America's Stake in Western Europe.* Chicago 10: Science Research Associates, Inc., 57 West Grand Ave. 1959. 68 pp. 50¢. America's involvement in Western European affairs as a vital problem in today's interdependent world. Against a backdrop of the major issue of Western European unity and the cold war, specific problems such as negotiation with the Soviets, nuclear disarmament, France and Algeria, German reunification, and the role of neutral countries are considered.

Directory of Camps. Martinsville, Indiana: American Camping Association, Inc., Bradford Woods. 1959. 280 pp. 50¢. Over 3000 camps are listed alphabetically by states. An extensive index is incorporated in the Directory. It includes location of the camp; name and address of owner or operating organization; number, ages, and sex of children served; fees; facilities; and program features.

FINNEY, G. E. *Life is a Journey.* New York 18: Longmans, Green & Co., Inc., 119 West 40th Street. 1959. 247 pp. $3.50. The close-knit Simmonds family is a happy one. In addition to Father, Mother, and Gramps, there are Stanley, a Korean War veteran; Barbara, hoping to attend college in Switzerland; Jud, the younger brother; and Mary Amantha, who is ten. Often separated while Stanley was in Korea and Father away logging, they have settled down for a happy summer at their lake-camp home, where Stanley will assist his father at logging. Unexpectedly they are asked to take in a young heiress who does not know how to live in a family.

FULLER, EDMUND, and OLGA ACHTENHAGEN, editors. *Four American Novels.* New York 17: Harcourt, Brace and Co. 1959. 669 pp. $3.20. This book contains the following four novels: *The Scarlet Letter* by Nathaniel Hawthorne, *Moby Dick* by Herman Melville, *The Red Badge of Courage* by Stephen Crane, and *The Bridge of San Luis Rey* by Thornton Wilder. Each novel begins with an introduction and closes with a 2,000-word *Afterwards* by Mr. Fuller. This ending discusses the larger questions of interest in the novel, its philosophy, why it has endured during the years, its central meaning for young people, and its place in American literature. Following the *Afterwards* section are study questions by Miss Achtenhagen. She has also prepared a 32-page *Teacher's Manual* containing a brief introduction to teaching the novels, additional questions, a synopsis of each novel as a refresher on the content and structure, an annotated bibliography of critical and background books about both the authors and the novels. Melville's novel is abridged—but not rewritten or adapted in any way—about 40 per cent by Mr. Fuller while the other three novels are complete.

GARBER, L. O. *The Yearbook of School Law—1959.* Danville, Illinois: The Interstate Printers and Publishers, Inc., Jackson and Van Buran. 1959. 182 pp. $3. The tenth in this extremely valuable series of yearbooks of school law, this 1959 edition presents authoritative but easy-to-read reviews and analyses of the most significant court decisions dealing with schools and school districts that were decided in the higher State and Federal courts during the past year. The specific classification of the contents are as follows: Chapter I. The State and Public Schools; II. School Districts and School Officers; III. School District Organization; IV. Liability of School Districts, Officers, and Employees; V. School Property; VI. School Finance; VII. Teachers and Other Employees; VIII. Pupils and Pupil Services; and IX. Particularly Significant Cases Decided During the Past Year. Among the particularly significant cases in Chapter IX are: "Removal of Teacher for Insubordination," "Disciplining High-School Pupils Who Marry," "Disciplining Pupils for Acts Committed on School Busses," and "Liability of District for Injuries Received by a Spectator at a Football Game."

Added features include two special articles, "Legality of Teacher-Retirement Legislation" by Milton Miller, principal of the Chester A. Arthur Elementary School, Philadelphia, and "School Law in Retrospect" by Dr. Garber himself. In addition, there is a most valuable and informative "Annotated Bibliography of Recent Studies in School Law" by Dr. M. R. Sumption of the University of Illinois.

Gifted Children. Cullowhee, North Carolina: Guidance Clinic and Extension Division, Western Carolina College. 1959. 32 pp. This is a brief description of a special class brought to the Western Carolina College campus as a part of the Summer Demonstration Schools which it operates for a six-week term each summer in support of its program of teacher education. These same children will return in the summer of 1959. In addition another similar group who will have completed the fifth grade by the end of the school year 1958-59 will be selected. Following the college's experiences with these two groups, it is planned to prepare a bulletin which will again make a record that may be helpful in evaluating the worth of such experimental endeavors. It is quite possible this bulletin will also cover experiments in the teaching of French at the fourth-grade level and the teaching of college chemistry to a selected group of high-school students who will have completed the eleventh

grade. The college expects to operate both these latter programs in the summer of 1959, each for a period of six weeks.

GUILLOT, RENE. *Prince of the Jungle.* New York 10: Criterion Books, Inc., 257 Fourth Avenue. 1959. 215 pp. $3.50. According to Kiang custom, young Raani must submit with his peers to the ritual test of the tiger if he is to suceed his father as Khan of the wildest jungle province of India. And Raani's rival, Yasin, his equal in strength and skill, is under the protection of the powerful high priest of Kali.

HAYCRAFT, M. C. *Too Near the Throne.* Philadelphia 5: J. B. Lippincott Company, E. Washington Square. 1958. 237 pp. $3.50. Even as a small child, Arbella Stuart was aware of two important facts: that she might someday succeed Elizabeth as Queen of England and that people near the throne lead dangerous, uncertain lives.

MARSHALL, PETER. *The First Easter.* New York 36: McGraw-Hill Book Company, Inc., 330 West 42nd Street. 1959. 151 pp. $3.50. The author's version of the great Easter story is exciting, reverent, and, above all, graphic. The characterizations in this book are acutely drawn and poignantly real. The Savior, Simon Peter, Judas, Pilate, Caiaphas, and Mary Magdalene—these and others all appear in memorable three-dimensional portraits. The author observes the dramatic changes wrought in the apostles by the Resurrection. He captures both the essential significance of Christ's crucifixion in His own time and, in a summation to the book, the meaning of Easter for today's Christians.

McCORMICK, WILFRED. *The Proud Champions.* New York 18: David McKay Co., Inc., 119 West 40th St. 1959. 186 pp. $3. Here is a dramatic story of baseball. As coach of Koulee High, Rocky McCune is plunged into an extremely awkward situation when his team secretly launches a move to make him Coach of the Year. He can't be too tough with them—they did it through an overdose of pride in him. But coming on the eve of the regional tournament, the scheme gets Rocky off to a bad start with rival coaches and fans alike.

MILLER, H. M. *Thunder Rolling.* New York 16: G. P. Putnam's Sons, 210 Madison Avenue. 1959. 190 pp. $3. In the early West, no Indian leader ever made the United States Army look more foolish than did Chief Joseph of the Nez Perce tribe. To fight against two thousand soldiers, Joseph seldom had more than fifty warriors. In addition, he was always burdened by women, children, and the baggage of his band. Yet he held the Army at bay for months in a running battle that twisted for fifteen hundred miles across Oregon, Idaho, Wyoming, and Montana. So skillful was Chief Joseph that his admiring enemies called him "the Red Napoleon of the West." But for all his success in war, Joseph was not a military leader. He was the peaceful chief of a peaceful tribe. Never did his band ask more than to live quietly in the Oregon lands that had been theirs for centuries. Their history of friendship with the white man was the longest of any Western tribe.

NEA RESEARCH DIVISION. *Mathematics and Science Teaching and Facilities.* Washington 6, D. C.: National Education Association, 1201 Sixteenth Street, N.W. 1959. 49 pp. (8½" x 11"). 50¢ for a single copy; 2-9 copies, 10% discount; 10 or more copies, 20%. This second report in the Research Division's new Monograph Series is taking the place of the reports formerly published as *Research Bulletins.* The *Bulletin* is now a popular treatment of the highlights of several studies rather than a full technical report on a single

study. This study represents an interim attempt to offer facts upon which to make analyses, present a generalized national picture, plan future trends in instruction, and indicate additional areas for further research in secondary education.

NIXON, E. W., and F. W. COZENS. *An Introduction to Physical Education.* Philadelphia 5: W. B. Saunders Company, W. Washington Square. 1959. 299 pp. $4.25. The fifth edition of this book seeks to maintain the two primary purposes for which the book was originally written in 1934—to provide prospective teachers with a general concept of the meaning and interpretation of physical education, and to present a description of what is involved in preparation for teaching in this field. The text aims to provide sufficient basic information to stimulate the formation of the student's point of view with relation to his field of study. It makes extensive use of selected chapter references and an alphabetical bibliography as a guide for further investigation.

The material in the text, supplemented by outside study of the selected references, makes this text particularly adaptable for use in either introductory and orientation courses or courses concerned with principles and philosophy designed for more advanced students. The authors feel that teachers and administrators may find this book extremely valuable for use in interpreting physical education to faculty members in other educational fields, as well as to interested school board officials and to many citizens and parents who seek a description of the meaning and value of physical education in the school curriculum.

NUTLEY, G. S. *How To Carry on a Conversation.* New York 16: Sterling Publishing Co., Inc., 419 Fourth Ave. 1959. 210 pp. $1.95. Some people are at a loss for words, some talk too much. But whatever the conversational problem, the author offers some answers in the new revised edition. The aim of this book is to teach everyone how to turn talk into a two-way street of smooth-flowing conversation that really communicates. Her helpful hints on career conversation, repartee, small talk, light stories, and telephone chatter show everyone—from the bashful teenager and tongue-tied toastmaster to the self-conscious salesman—how to develop the gentle art of making interesting, exciting, and vital conversation on the job, socially, at home or at school.

OLIVA, P. F. *Instructional Aids and Sources for Foreign Languages.* Gainesville: Committee on Publications of the College of Education, University of Florida. 1959. 40 pp. 60 cents each for 1-3 copies; 55 cents each for 4-9 copies, and 50 cents each for 10 or more copies. This bulletin, a recent service publication of the College of Education, is a handy reference which lists many aids and sources of foreign language materials, including books, films, records, realia, information centers, *etc.* As an added feature, the booklet includes a glossary of some 1,000 common words in English, Latin, French, Spanish, and Italian.

ORR, JR., CLYDE. *Between Earth and Space.* New York 11: The Macmillan Company, 60 Fifth Avenue. 1959. 263 pp. $4.95. The author takes the reader on a fascinating journey through the air about us. His book provides an authoritative, timely, and readable profile of the earth's atmosphere. In clear, nontechnical language, the author covers a wide range of subejcts—the beginnings of atmosphere; the regions above the earth; weather, climate, and the elements; vibration in air; air pollution; and supersonic flight.

PLATIG, E. R. *The United States and World Affairs.* Chicago 10: Science Research Associates, Inc., 57 West Grand Ave. 1959. 92 pp. 50¢. A

well-balanced look at general problems in American foreign policy. Are foreign relations necessary? What are the ends of our policy and what means do we employ to achieve them? How is foreign policy made? In addition to such basic inquiries, the booklet includes a case study on the Mutual Security Programs.

PORTMANN, ADOLPH. *Animal Camouflage*. Ann Arbor, Michigan: The University of Michigan Press. 1959. 111 pp. $4.50. Here is a book about the earth's most delightful masquerade—animal camouflage. With rare thoroughness and lively affection, the author pictures a world that will fascinate the novice and the expert—skindiver, birdwatcher, fisherman—anyone who has ever wondered at the changing faces of nature.

POWELL, TALMAGE. *The Smasher*. New York 11: The Macmillan Company, 60 Fifth Avenue. 1959. 154 pp. $2.95. A telephone rang—and Steve Griffin recognized the distant, terrified voice of his wife. "He's trying to run me down with a car. He's trying to smash the life out of me, Steve." But who her pursuer was Maureen never lived to tell.

What would drive an unknown man to kill Maureen, to smash out her life with an automobile which was the twin of Griffin's own? Steve Griffin could think of nothing that would explain this nightmare. Then a special delivery letter came to his office. It had only a single, typewritten line: "You owe me the kid too, Griffin." And now, desperately frightened for the safety of his young daughter, Steve knew he had to seek out the murderer himself. He realized he was seeking no ordinary hit-and-run driver, but a deadly menace who had sworn to kill again.

Practices in Teaching Gifted Students in English. Jamaica 32, New York: Jamaica High School, 168th Street and Gothic Drive. 1959. 36 pp. (multilithed) $1. This is a compilation of reports of Jamaica High-School teachers of actual practices in the past year, and includes perhaps the most complete bibliography on the teaching of such students yet compiled.

School Mental Health Project. Detroit 1: Michigan Society for Mental Health, 153 East Elizabeth. 1958 (December) 16 pp. This third-year summary represents a status report of the progress of project programs and activities. The purpose of the project is to help the schools of the state to make the learning environment and conditions such as to insure the development of mental health among youth—this to be achieved through the provision of special training and assistance in mental health education for teachers and other school personnel. More than 1,000 teachers and student teachers participated in the program.

SCHURZ, W. L. *American Foreign Affairs*. New York 10: E. P. Dutton and Company, 300 Fourth Avenue. 1959. 265 pp. $4.50. Getting on with other nations is the subject of this survey. As the author points out, the American people are now spending more than a seventh of their gross income for the maintenance of their country's foreign policies. His book is designed to advance an informed public opinion on the subject. The book discusses how we form our opinions of other nations, and how in turn we present ourselves to them. It shows how nations, as entities, come into being and what the prerequisites are for survival. There is a survey of United States relations with other countries of the world by country and area—how we have fared in the past and what the future may hold. A final section discusses the organization of our State Department and how policy is made and carried out.

SERRAILLIER, IAN. *The Silver Sword.* New York 10: Criterion Books, Inc., 257 Fourth Avenue. 1959. 187 pp. $3.50. Within an hour after the Germans came for their mother, the Balicki children's native Warsaw held neither home nor parent. Only determination, luck, and the help of unexpected friends kept the three together—until Edek fell into the hands of the secret police. How Ruth manages to carry on without Edek, and sets out with little Bronia in search of him and their parents, is told with a deceptive simplicity which gives a deep insight into what life was like for the youth of World War II.

SKINNER, JOHN. *Spare Not for Their Crying.* Boston 20: The Christopher Publishing House. 1959. 535 pp. $4.75. Richard Ragsdale had just recently returned from the service, and after many years was resuming his career in the field of education. He had been offered the position of principal of the Hinsdale Senior High School in his old home town, Allerton. He accepted. It would be nice, he thought, to return to the quiet country life of Allerton with his lovely wife, Mag. Being principal of a high school would be an entirely new experience for Dick, but he felt positive that, with his education and military background, he would be able to handle this new responsibility with little trouble. As the new school year began, and he began to know the students in his school, he soon learned that the job of principal of Hinsdale Senior High School was no easy task. In the past, the school had gotten out of hand, and it was Mr. Ragsdale's job to straighten it out and raise its standards of education from the depth to which it had descended. Throughout the pages of this novel, the reader is introduced to many of the students, mostly those with problems. Each student has a story behind him or her which adds considerable interest to this book.

SLATER, FRANK. *Oil Painting for Everyone.* New York 17: Charles Scribner's Sons, 597 Fifth Avenue. 1958. 96 pp. $3.50. This is a book aimed at all beginners, whether they are young people considering painting as a career or older people who want to take up painting as a pastime. In either case, the author stresses, the approach should be a serious one so that the greatest profit and pleasure can be derived from mastering the craft. The necessary materials are explained, and the techniques of still life, landscapes, and portraits are taken up in detail. The directions given are clear, and concise; throughout the book, not only the "how" of each step is explained, but also the "why."

STUMPFF, KARL. *Planet Earth.* Ann Arbor, Michigan: The University of Michigan Press. 1959. 191 pp. $5. The first photograph in this book was taken from a V2 rocket 200 miles up in the stratosphere. It shows a small curved segment of the earth outlined in blackness, and is man's nearest approach to seeing the earth as a planet rolling through space. The hot interior of the earth is even harder to investigate. Yet science gives us an astonishingly detailed and vivid account of our planet.

THORPE, L. P., *et al. Studying Social Relationships in the Classroom.* Chicago 10: Science Research Associates, Inc., 57 West Grand Ave. 1959. 49 pp. $1. A handbook for teachers, counselors, and administrators in elementary, junior high, and senior high schools, composed of 4 chapters—"Why Study Social Relationships in the Classroom," "The Sociometric Test," "Interpreting Sociometric Data," and "How To Use the Results of Sociometric Testing"—a conclusion, and a bibliography of 8 books.

VAN BUREN, ABIGAIL. *Dear Abby.* Englewood Cliffs, N. J.: Prentice-Hall, Inc. 1958. 215 pp. $2.95. The author, whose "Dear Abby" column is featured in 200 newspapers in the United States, Hawaii, and Canada, with a reading public of more than 30 million people includes some of her experience and advice in this book. From her answers to an average of 7500 letters weekly, she selects some of these "Essays by Abby" and presents them in book form.

Where Does Your Community Stand in Financing Its Schools? Lexington: Bureau of School Service, College of Education, University of Kentucky. 1959. 46 pp. 10¢. This report compares the school districts of Kentucky to each other in some of the ways they finance their schools; also includes the NEA's estimates of expenditures per pupil in A.D.A. for all states.

YODER, R. M., Editor. *The Saturday Evening Post Carnival of Humor.* Englewood Cliffs, N. J.: Prentice-Hall, Inc. 1958. 380 pp. $7.50. From a half century of good reading in *The Saturday Evening Post* comes this distillation of funny and nostalgic stories, articles, epigrams, cartoons, and verse by America's greatest humorists.

YOUNG, MIRIAM. *Marco's Chance.* New York 17: Harcourt, Brace and Company, 750 Third Ave. 1959. 190 pp. $3. Even though the kids in school made fun of his English, twelve-year-old Marco, who had just come to the United States from Sicily with his mother, didn't mind. After all, it was friendly teasing, and didn't he and his parents live in a house all their own and have a wonderful second-hand car? And hadn't his father, who had come to this country before them, promised Marco he too might work in the sand and gravel pit when he was old enough? So Marco made friends and enjoyed every minute of the new life until he discovered that his mother—homesick, lonely, and unwilling to learn English—was determined to go back to Sicily, taking Marco with her. How Marco planned and worked to change her feelings, to make her realize home could be in the United States as well as Italy, is the heart of a perceptive, eventful, often humorous and always warmly human story.

ZIM, HERBERT. *The American Southeast.* New York 20: Golden Press, Rockefeller Center. 1959. 160 pp. $2.50. This second Golden Regional Guide (a companion volume to *The American Southwest*) is an invaluable aid to tourists and armchair travelers alike. The climate, geology, history, national and state parks, monuments, and modern industries of Florida, Louisiana, Mississippi, Alabama, Georgia, and South Carolina are described. Beautiful illustrations (345 color pictures in all) identify the palms, shrubs, flowers, tropical plants, fish, reptiles, amphibians, birds, and mammals of the region. And, furthermore, this richly illustrated, carefully researched miniature encyclopedia is just the right size to fit easily into a pocket, or into the glove compartment in a car.

News Notes

PRELIMINARY SCHOLASTIC APTITUDE TEST

The Trustees of the College Entrance Examination Board announced that the Board has decided on two courses of action, one immediate and the other long range, in response to the concerns expressed by schools and colleges over the rapidly growing problems of college admission. The College Board is a non-profit association of school and college members established in 1900 to facilitate the transition of students from school to college. The membership now consists of 250 colleges which require the examinations for admission and 37 educational associations representative of school interests throughout the nation.

The first move authorized by the Trustees will be the introduction of a new test, to be known as the *Preliminary Scholastic Aptitude Test*, designed especially to assist schools in advising their college preparatory students early in the junior year. The test will be given nation-wide in October at every school wishing to obtain for its college-bound juniors information which will provide (1) a forecast of their performance in the senior year on the *Scholastic Aptitude Test* when it is taken for college admission, and (2) an advance indication of their college capability which will be particularly helpful in arriving at a good and realistic choice of college.

It is estimated, on the basis of current trends toward earlier guidance, that the *Preliminary Scholastic Apititude Test* will be taken by approximately 500,000 students in some 15,000 public and private schools. The combination of economies achieved through this large volume and the cooperation of schools in administering the test to their students will make possible a fee of only one dollar per student. The test will also be open to seniors who hope to qualify for scholarship programs conducted by sponsoring businesses, educational societies, and fraternal organizations which will require the test as part of their selection procedures. In 1958 over 1,600 scholarships were awarded to seniors taking the College Board's Scholarship Qualifying Test, which will be discontinued this year in favor of the *Preliminary Scholastic Aptitude Test*. Information on participating scholarship sponsors will be sent to schools this spring and in the fall.

The Preliminary Scholastic Aptitude Test will be a two-hour version of the three-hour *Scholastic Aptitude Test*, using the same kinds of multiple-choice questions and measuring the same verbal and mathematical abilities. It will yield separate verbal and mathematical scores on a scale ranging from 20 to 80, a graduation parallel to that of the College Board's standard admissions test scale of 200 to 800. This will make it a simple matter for guidance officers to relate the preliminary test scores directly to admissions test score information. Interpretive information will be sent to schools with the scores.

The *Preliminary Scholastic Aptitude Test* will be given on two dates in 1959: Tuesday, October 20, and Saturday, October 24. A school may choose either date, but all students of the school must register only for the one date chosen. A different form (edition) of the test will be used on each date in order to maintain the security of the test in a manner which will make it equally fair to students of every school. The school must agree to administer the form for which it has registered on the designated date.

The test may be given at any secondary school in the United States and its territories and possessions. It will be administered by the school principal or his designated representatives. Arrangements for registration will be made through the Educational Testing Service (Box 589, Princeton, N. J.), which will operate the program for the College Board. Complete information on the test and scholarship sponsors will be mailed early in September, at which time schools will be asked for their final registrations. The test scores will be reported in December to schools and to the scholarship programs specified by senior candidates.

The second action was the creation of a permanent Committee on Entrance Procedures "to study the problems in the area of college entrance procedures, to initiate and oversee the collection and dissemination of information relating to these problems, and to develop for consideration possible solutions to these problems."

SUGGESTED CERTIFICATION REQUIREMENTS FOR SCIENCE TEACHING

A study committee of the American Association for the Advancement of Science (AAAS) has proposed that college students preparing to teach high-school mathematics and science devote at least half of their program to preparation in those teaching areas. It also called on colleges and certification authorities to work toward a five-year program for the preparation of high-school teachers.

These are the suggested requirements for future teachers in the various fields of science: *Biology*—30 hours of biology, 12 of chemistry, 8 of physics, 3 of earth science, and 6 of mathematics. The fifth-year program would include 12 hours of biology, 4 hours each of chemistry and physics, and 2 hours of math. *Chemistry*—28 hours of chemistry, 8 hours each of physics and biology, 3 of earth science, and 12 of mathematics. The fifth year would have 18 hours of chemistry, and 6 each of physics and mathematics. *Physics*—25 hours of physics, 13 each of chemistry and mathematics, 6 of biology, and 3 of earth science. The fifth year would include 15 hours of physics, 10 of chemistry, and 5 of mathematics. *General Science*—10 hours of biology; 12 of physics; 8 of chemistry; and 6 each of earth science and mathematics, plus 18 from two or more of the four science fields, excluding mathematics.—*Education U.S.A.*, NEA.

EXPERIMENTS IN EDUCATION

An experiment in the use of teaching machines to strengthen student ability for self-learning will be conducted by Hamilton College, Clinton, New York, under a two-year grant of $204,310 announced today by the Ford Foundation. The grant will enable Hamilton to develop and test self-teaching-machine materials for courses in logic, mathematics, French, German, and psychology. The courses will be offered to 250 to 300 Hamilton College students and to high-school students from five school districts in the Oneida County, New York, area who are presently participating in a special program for gifted pupils.

"The machine to be used in the Hamilton College experiment is essentially a device to improve the student's capacity to learn independently," according to Clarence H. Faust, vice president of the Foundation. "Because it enables the student to teach himself a great deal of the routine drill work material in his courses, it frees the teacher to concentrate on those aspects of learning

where his talents are most sorely needed. It is a promising advance in the application of technology to help make better use of our short supply of school and college teachers.

"The unique feature of the machine is that it requires the student to construct his answer rather than merely to recognize it. It does not employ the multiple-choice method," Mr. Faust said.

The Hamilton experiment will employ a slightly modified version of a machine originally devised and developed by B. Frederick Skinner, professor of psychology at Harvard University. It consists of a box-like structure with two small windows. Lessons in the form of a series of questions and answers are microfilmed and arranged on a filmstrip, which is inserted into the machine by the student. Questions appear one at a time in one of the two windows, and in the other, there is a section of paper tape on which the student writes his answer. He then moves a lever that covers what he has written with a transparent shield, so that he can still see it but can't change it. At the same time, the correct answer appears in the first window. The teaching technique employed in the machines combines modern versions of the "Socratic" method, or the question-and-answer system, and the "Cartesian" method, which requires the analysis of problems into their smallest parts. Steps between one question and the next are small, so that the student gets a complete understanding of the material, unit by unit, as he works through it. Moreover, the machine gives him the advantage of working at his own pace.

The College anticipates that it will give credit toward advanced standing to high-school students who successfully complete college-level work with the aid of materials prepared for presentation in the self-teaching machines.

Following is a list of recent new grants announced by the Foundation:

National Program in the Use of Television in the Public Schools—three grants totaling $29,156 to the University of North Carolina ($11,400), the Board of Education of the School District of the City of Detroit ($11,000), and the University of Nebraska ($6,756), for continued assistance for their participation in a national experiment in the use of classroom instruction by television in the public schools.

Rand Corporation—$35,000 grant, for an experiment in the application of the "system analysis" technique to a local school system in California. The technique, which has been used by the United States Air Force, involves the analytical comparison of the probable costs and other effects of alternative means of achieving a given objective. The purpose of the experiment is to determine ways in which "system analysis" might help schools make better use of their personnel and other resources in raising the quality of education.

Rutgers University—$25,000 grant, for a workshop to be conducted in the summer of 1959 by its School of Education and the English Department of its College of Arts and Sciences for English teachers from high schools throughout the country. The workshop will focus on the practical application of the principles and materials for improving the teaching of English that were developed by the Educational Testing Service, Princeton, New Jersey, in its experiment on the use of lay personal to assist English teachers in grading and correcting written papers.

University of Alabama—$5,000 grant, for five regional meetings of principals and other school personnel in connection with the Alabama Television Project, a state-wide experiment in the use of classroom instruction by television in the public schools.

1,000 BOYS ATTEND HIGH SCHOOLS ON SATURDAY MORNINGS

Each Saturday morning, boys enrolled in the six high schools in Sewanhaka Central High School District No. 2, Stewart Manor, New York, voluntarily attend a recreation program at each school. Physical education and recreation activities include: lacrosse, football, volleyball, medicine ball, push ball, table tennis, shuttle-loop, net games, basketball skills, badminton, wrestling, weight-lifting, tumbling, trampoline, calisthenics, horizontal and parallel bars, horse, ropes, rings, vaulting-box, gymnastics. At each school two or three qualified physical education teachers act as leaders. The six schools are: Sewanhaka High School, H. Frank Carey High School, Elmont Memorial High School, Floral Park Memorial High School, New Hyde Park Memorial High School, and Alva T. Stanforth Junior High School.

IDENTIFYING TALENTED STUDENTS

A four-year research program to help high schools do a better job of identifying, developing, and utilizing student talents will be supported by the U. S. Office of Education under the Cooperative Research Program. The project will be conducted by the University of Pittsburgh at an initial cost of approximately $500,000, of which the university will provide about $75,000. Total scope of this research program and its ultimate cost will be determined by the extent of interest shown by other Federal agencies. Federal support may ultimately reach about $1 million.

About half a million boys and girls in 1,400 high schools across the country—approximately 5 per cent of the total high-school enrollment—will be participants in the study. They will provide information designed to enable their schools to determine the nature of their talents, career interests, educational plans, and progress in their education toward their objectives. Over-all purpose of the project is to help educators develop to the full our available human resources in meeting scientific, professional, cultural, occupational, and civic needs. It has also been proposed that follow-up studies of the students be made 5, 10, and 20 years after each member of the group has been graduated from high school.

RUSSIAN WORKSHOP AND INSTITUTE FOR TEACHERS

The Ninth Annual Russian Workshop and Institute for Teachers will be held on the Bloomington campus of Indiana University from June 15 to August 7, 1959. In order to help meet the new demand for teachers and others with a working knowledge of Russian, the program will be lengthened to eight weeks, corresponding to the length of the regular Summer Session. Registration in this intensive eight-week course will be limited. The maximum number in each class is kept small, so as to insure the greatest possible teacher-student contact.

The purpose of the Russian Workshop and Institute is to provide the best practicable situation for an American to work toward mastery of the Russian language. Concentrating on this subject for a period of eight weeks will make it possible for the student to complete an entire stage of mastering the language, the equivalent of a whole year of an intensive language course in college. The oral approach to learning Russian will be stressed on all levels, though reading and writing will not be neglected; students on the more advanced levels will be using Russian exclusively. For the eight weeks, students go to class together, eat together, study together, and enjoy recreation together.

The need for a more widespread knowledge of the Russian language among Amercans has now become self-evident. The question is no longer whether Russian should be more generally taught, but rather how we can best meet the immediate need for more teachers of Russian and more persons in science, government, industry, and journalism with a working knowledge of the language. The course in the Russian Workshop and Institute is designed to be applicable to the program of all students wishing a mastery of Russian, whether majors in language and literature, in the Russian area, prospective or active teachers, or individuals preparing for other professional use of the language. For particular information write to The Russian Workshop and Institute for Teachers, Department of Slavic Languages and Literatures, Indiana University, Bloomington, Indiana.

CAPE CANAVERAL LAUNCHINGS

Meston's Travels, 35 mm color slide manufacturer of El Paso, Texas, announce the addition of 40 official United States Air Force photos of launchings and pre-launchings taken at Cape Canaveral. These are historically valuable slides that many will want to see and keep. The original transparencies were made by official United States Air Force Photographers in full color and with eye-witness realism. The 40 slides include the Convair, Thor, Explorer, Jupiter, Atlas, Vanguard, Redstone, Navajo, Juno, Bomarc, Snark, and Matador. For further information concerning these slides, contact Meston's Travels, Inc., 3801 North Piedras, El Paso, Texas.

A SPACE PRIMER

A 72-page booklet on astronautics, called the *Space Primer*, has been published by Convair (Astronautics) Division of General Dynamics Corporation, builder of the Atlas intercontinental ballistic missile. The booklet, prepared by the astronautics staff, offers clear explanations of such subjects as rocket propulsion, the motion of satellites, and ways in which man can reach the moon and planets. The publication contains a glossary of rocket and space terms, a list of books and magazines on space, and a section on preparing for a career in astronautics. Single copies may be obtained free by writing Convair-Astronautics Department 120, P. O. Box 1128, San Diego, California. Bulk quantities are available at a nominal charge.

HIGH QUALITY EDUCATION A MUST

Just how much is education worth? To the individual it determines his life-long personal earnings. A college graduate at the peak of his earning power, has an average income that's 70 per cent higher than when he first started to work. But a man who goes no further than high school can expect to earn only 14 per cent more than his starting salary. That information comes from the U. S. Department of Commerce and is one of scores of conclusions about education gathered from recognized reliable sources and published in a 62-page booklet released by the Committee on Tax Education and School Finance of the National Education Association. (1201 Sixteenth St., N. W.) The booklet is titled *Citizens Speak Out on School Costs* (50¢).

"That there is a positive relationship between economic productivity and provision for education is a fact," reports the booklet. "This holds whether one studies the relation between education and productivity among nations,

among states in the United States, or among individuals." Facts and conclusions presented in the booklet come from such diverse sources as citizens' commissions, the National Science Foundation, the Chamber of Commerce, various presidential committees and commissions, and special projects such as the Rockefeller Report on Education, and several others. They are facts which should be considered, according to NEA officials, by local committees, state legislatures, and by the Congress as they decide how much money will be spent on education during the next fiscal period.

The relationship between good schools and taxable wealth is a which-comes-first-the-chicken-or-the-egg type of controversy, the booklet says. "Start with either wealth or education, and the progress of one contributes to the progress of the other. More and better education contributes to economic advance and increased wealth. Increased income and wealth permit better financing of schools. . . ."

HANDBOOKS FOR STUDENTS AND PARENTS

The four high schools in the Plumas Unified School District, with headquarters in Quincy, California, have developed a new approach to a *Student-Parent Handbook*. Each school has its own handbook which is divided into two sections. The first section contains district-wide information applicable to all schools such as school calendar, attendance policies, graduation requirements, and college entrance requirements. The second section, printed on different colored paper, has information pertaining to individual high schools. Topics such as counseling services, extracurricular activities, PTA, student awards and clubs are usually included, but vary among the schools.

Each fall during the first two weeks after the opening of school, home-room teachers spend some time each day in class discussion covering the topics in the handbook. Following this review, the student addresses the handbook to his parents in the space provided on the back cover and they are sent to the office for mailing. This method not only serves as an orientation for the new student, but also as a refresher for the returning student. Parent response has been very favorable as the handbook provides a rather complete overview of their high school.

JOHN HAY FELLOWSHIPS FOR 1959-60

Sixty-three public high-school teachers have been awarded John Hay Fellowships for a year of study in the humanities. These teachers, who represent high schools from coast to coast, are drawn from the fields of history, English, foreign languages, fine arts, science, and mathematics. Each Fellow will receive a year's leave from his school system and will study in the humanities at one of five cooperating universities: Chicago, Columbia, Harvard, Northwestern, and Yale. Fellowship stipends include a sum equivalent to the teaching salary for 1959-60 in addition to full tuition and transportation costs for the Fellow and primary dependents. Approximately one third of the participating systems have been able to grant sabbatical leave with pay to their Fellows. The Newton, Massachusetts, High School set a new precedent by providing one full salary.

The John Hay Fellows Program, operated by the John Hay Whitney Foundation through its recently established Greenwood Fund, was set up in 1952 and since then has provided twenty fellowships annually. Its expansion in

In the exact sciences
Precision tools are essential

HOLT TEXTBOOKS IN MATHEMATICS

Provide the precision required
To support high-quality teaching and thorough basic training
In the modern classroom

Morgan-Paige

ALGEBRA 1 and ALGEBRA 2

Well-planned, consistent study pattern • verbal problems introduced from the outset • demonstration solutions of problems carefully explain each new type • enrichment materials challenge the most gifted students • Both texts available with our without *Answers.* • Teacher's Manual with Complete Answers and Basic Solutions; Tests, Keys.

Schacht-McLennan

PLANE GEOMETRY

Stress on concepts and structure of geometry lead to understanding of the nature and meaning of proof • Thorough development of standard course extended naturally to include solid and coordinate geometry • Skilfull blending of traditional subject matter with modern viewpoint makes this text adaptable for use in all contemporary classrooms. Teacher's Manual with Answers and Basic Solutions; Tests, Key.

Hooper-Griswold

A MODERN COURSE IN TRIGONOMETRY

Complete 1959 revision. Considerable stress on analytical trigonometry, with thorough treatment of fundamentals • A precision tool that combines triangles and analysis, functions of angles and periodic functions, vectors and logarithms. A modern approach to a basic course. Teacher's Manual with Answers and Basic Solutions; Tests, Key.

HENRY HOLT AND COMPANY

383 Madison Avenue, New York 17 • 536 Mission Street, San Francisco 5

When writing advertisers mention THE BULLETIN

1959-60 is made possible by a grant from the Ford Foundation. In announcing the awards for next September, Dr. Charles R. Keller, Director of the John Hay Fellows Program, said: "These Fellowships help to improve the quality of education in the United States. Outstanding teachers have opportunities to study and to think and thereby to recharge their intellectual batteries. School administrators make effective use of these teachers when they return from their fellowship year. Students derive rich benefits."

FILMSTRIPS ON COMMUNICATIONS

Adventures in Communicating is a new set for four filmstrips in color on sentence structure and use, produced by Filmstrip House, 347 Madison Avenue, New York, for elementary and junior high-school use. *How We Communicate, What Is a Sentence? Sentence Variety,* and *Sentence Do's and Dont's* are the individual titles. They are by Reid Irving, Baltimore English teacher. The set is a sequel to *Adventures in Words.* The two sets are offered in combination at $30; in single sets at $20; and individual titles at $6. The new series shows how all five senses are used in communicating and then teaches ten principles essential to proper use of sentences in written communication. Color is used functionally to familiarize the student with parts of speech and their use in different sentence patterns. Emphasis is placed on avoiding comma splices, fragments, and faulty reference.

WANTED: PLAYS FOR HIGH-SCHOOL YOUTH

Plays, the drama magazine for young people, announces a playwriting contest with $750 in cash awards for original one-act plays suitable for production by young players. A total of $750 in cash prizes will be awarded: two first prizes of $200 each; two second prizes of $100 each; and two third prizes of $75 each. Awards will be given in two different categories: plays suitable for production by junior-senior high-school age groups and plays suitable for production by lower-intermediate age groups. Any unpublished play written in English may be submitted and contestants may enter one or more manuscripts. Prize-winning plays will be published in *Plays* magazine; other plays submitted may be purchased for publication at regular rates. The contest closes July 31, 1959. Further information may be obtained by writing to Contest Editor, *Plays Magazine,* 8 Arlington Street, Boston 16, Massachusetts.

TEACHING MATHEMATICS IN SECONDARY SCHOOLS

The fear of mathematics is more widespread than it should be. "We can make little progress toward its prevention until the teachers of very young children are themselves sufficiently secure and confident in their own mathematical powers to be able to meet their pupils' difficulties with patience and understanding." This view is expressed in a pamphlet, *The Teaching of Mathematics in Secondary Schools,* recently published by the British Ministry of Education.

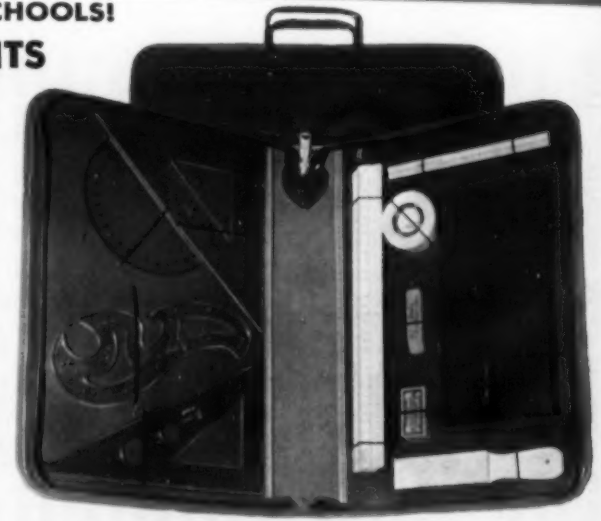
In a foreward, Mr. Geoffrey Lloyd, Minister of Education, says "Our standard of living and our position in the world depends upon our ability to remain in the forefront of scientific advance, both pure and applied. . . . While the precise content of a mathematical education is a matter of opinion—for we can never know which abstract branch of the subject will next prove to have a practical application—we can be certain of one thing, that mathematics must

USED AND PRAISED IN HUNDREDS OF SCHOOLS!

USED AND PRAISED IN HUNDREDS OF SCHOOLS!

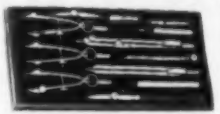
BERGER "all-in-one" DRAFTING KITS

All needed drafting tools combined in this one easy-to-carry case! Students come to class fully equipped, don't have to beg the loan of a protractor, a triangle or scale. Sessions get under way promptly! Instructors in hundreds of schools say it's today's indispensable teaching aid. Tell your students about it.



YOUR CHOICE OF 8 DIFFERENT DRAWING SETS — PLUS

Protractor	French Curve
Engineer's Scale	Draftsman's Tape
Architect's Scale	Pencil Pointer
8" Triangle (45°-90°)	2 Drawing Pencils
10" Triangle (30°-60°)	2 Erasers



Berger Drawing Set #510 plus complete kit: $10.50

All in attractive, durable, 12" x 16" 3-way zipper carrying case of scuff-proof, waterproof Texon with slide-in handles. Inner compartments for papers. Opens to 16" x 24".

PRICES FOR COMPLETE KITS: $7.86 to $18.90

New Economy Size Porta-Draft Kits From $5.58

Choice of Drawing Sets . . . *PLUS*

Protractor	French Curve
12" Triangular Scale	Pencil Pointer
6" Triangle (45°-90°)	Drawing Pencil
8" Triangle (30°-60°)	2 Erasers

In handy 10" x 14" zipper carrying case of Texon. Two inner compartments for note papers. Opens to 14" x 20".

Prices quoted are for 6 or more kits. Instructors may buy sample kit at same low price.

BERGER SCIENTIFIC SUPPLIES, INC.

51 Williams St., Boston 19, Mass.

MAIL THIS COUPON TODAY!

BERGER Scientific Supplies, Inc.
51 Williams St., Boston 19, Mass.

Please send me descriptive literature and prices on Berger Drafting Kits.

NAME .....

SCHOOL .....

ADDRESS .....

CITY ..... Zone..... State.....

be taught as a language. Power of expression in this language, and its ready application, cannot be cultivated too early; the techniques of the subject can await time and opportunity. We have clearly reached a state at which our methods and curriculums need to be considered afresh. This pamphlet [available from Sales Section, British Information Services, New York, price $1.08, plus 8 cents for postage] makes many suggestions for the promotion of greater interest and efficiency, at the same time stressing the importance of the logical foundations and historical background of the subject."

A NEW SCIENCE FILM

Time, a new science film for classroom use, has been released by the Audio-Visual Center, Indiana University, Bloomington, Indiana. Through live photography, models, and animation, the film portrays scientific time determination, timekeeping, standard time zones in the United States, Daylight Saving Time, Greenwich Time, and the International Date Line. Teachers of science, mathematics, and geography in grades five through nine will find the film useful in teaching units concerned with time. It can also be used in high school and college beginning astronomy courses.

Opening with a montage of scenes pointing out how time regulates our daily lives, the film then illustrates with an animated sequence man's age-old use of the sun as a timekeeper. The development of time zones is traced, beginning with the need for standard time that arose when railroads were built across the United States. Determination of zone boundaries, based on one-hour time differences and meridians, is covered in detail. The film concludes with a series of questions which review the major concepts it has developed. It is 15 minutes in length, sound. Prints can be purchased, in color for $150 and in black and white for $75, from the Audio-Visual Center, Indiana University, Bloomington, Indiana, and from the Educational Film Library Association, 250 West 57th Street, New York 19, New York.

CATALOGUE OF EDUCATIONAL SCIENCE MATERIALS AND PROJECTS

A 36-page catalogue of science materials, oriented specifically toward educational science project work for all ages and experience levels, is offered free upon request by the Science Materials Center, a division of The Library of Science, 59 Fourth Avenue, New York 3. In addition to photographs and specific data on equipment and kits, projects that may be done with all the materials listed are suggested in detail. Special attention is given to materials for teaching science in grade and high schools. Also listed are books and periodicals that can be of particular help in planning projects for science fairs or contests, plus other sources of information on science projects and careers. Advisers to the new Science Materials Center are outstanding scientists and educators. All equipment is pre-tested by educators in each field of the physical and natural sciences.

PROGRAM FOR SUPERIOR STUDENTS

A program for superior students based on the principle of special curricular arrangements to match capacity to learn more quickly and to handle studies of greater difficulty and maturity has been authorized by the University of Illinois, effective September 1, 1959. Participants will be a group of superior students to consist of from 3 to 5 per cent of the entering freshman class who will be

INTEGRATED EVALUATION

The key question in the acceptance of a student at Devereux is, "Will the child profit by being in our care?" A thorough, integrated evaluation helps answer this question.

First in importance is the detailed history reported by the referring physician. Then the clinical staff at Devereux gives the student complete psychiatric, psychological, and medical evaluations. With the child assigned temporarily to a small home-school unit, this study covers his inter-personal reactions and his response to preliminary therapy.

Upon the outcome of this integrated evaluation, which is reported to the parents and the referring agent, depends the final acceptance of the child and the program of therapy that lies ahead.

MEDICAL-PSYCHIATRIC STAFF

J. Clifford Scott, M.D.
Walter M. Uhler, M.D.
Aurelio Buonanno, M.D.
Charles M. Campbell, Jr., M.D.
Ruth E. Duffy, M.D.
William F. Haines, M.D.
Herbert H. Herskovitz, M.D.
G. Henry Katz, M.D.
Chief Psychiatric Consultant

Robert L. Hunt, M.D.
Richard H. Lambert, M.D.
Leonardo Magran, M.D.
Jacob S. Sherson, M.D.
Albert S. Terzian, M.D.
Lance Wright, M.D.

Joseph J. Peters, M.D.
Psychiatric Consultant

THE DEVEREUX FOUNDATION

A nonprofit organization — *Santa Barbara, California*

Founded 1912 — *Devon, Pennsylvania*

SCHOOLS
COMMUNITIES
CAMPS
TRAINING
RESEARCH

HELENA T. DEVEREUX
Administrative Consultant

EDWARD L. FRENCH, Ph.D.
Director

WILLIAM B. LOEB
Treasurer

Professional inquiries should be addressed to JOHN M. BARCLAY, *Director of Development*, or CHARLES J. FOWLER, *Registrar*, Devereux Schools, Devon, Pennsylvania; western residents address KEITH A. SEATON, *Registrar*, Devereux Schools in California, Santa Barbara, California.

chosen on the basis of available records and tests, recommendations of high-school principals and teachers, and personal interviews. Members of this group will be known as Edmund J. James scholars and insofar as possible will be taught in special courses and sections, designed to exercise to the full their academic capabilities. Inclusion of sophomores, juniors, and seniors in the group of James scholars will be done in the second, third, and fourth years after the program is established.

A Faculty Honors Council will be appointed by President David D. Henry to work with the director of the university honors program. Jointly they will formulate and propose measures for improving the university's educational program for superior students for stimulating such students to their best efforts and for encouraging them by providing physical facilities conducive to study.

FAMILY LIFE EDUCATION

"Teacher Exchange for High School Family Life Educators" is appearing as a feature in *Marriage and Family Living*, the quarterly journal of the National Council on Family Relations. It provides a medium of communication which makes it possible for teachers to exchange ideas, and find answers to teaching problems through pertinent articles as they seek to educate young people for satisfying family living. It is available for $1.00 a year from the National Council on Family Relations, with the cooperation of the American Social Hygiene Association. Write the National Council on Family Relations, 1219 University Avenue, S. E., Minneapolis 14, Minnesota.

HEALTH SCHOLARSHIPS

Students who will be graduated from the high schools in the calendar year 1959 are eligible to apply for the new Health Scholarships of The National Foundation. These scholarships are designed for students planning professional study leading to the Baccalaureate degree at fully accredited institutions of higher education in five health professions—nursing, occupational therapy, physical therapy, medicine, and medical social work.

The National Foundation, supported by the March of Dimes, will offer annual Health Scholarships to help provide four years of college or university education in career preparation for five key professions. A minimum of 505 Health Scholarships will be offered annually beginning in 1959, each one renewable for three consecutive years depending upon the satisfactory performance of the student. In successive years at least 505 new scholarships will be offered annually. Awardee will receive $500 a year (that is, a maximum of $2,000 for four years of study). The scholarships will be made available to student citizens in each of the 49 states, Hawaii, the District of Columbia and Puerto Rico, and will be distributed on a geographical basis. No state or territory will offer less than five Health Scholarships—a minimum of one for each of the five professions. Scholarship winners will be selected by state and territorial committees composed of members of the five health professions. Awards will be made on the basis of financial need, scholastic achievement, motivation, and aptitude. The National Foundation's 3,100 chapters will have information and application forms available and will present awards to winners.

Awards will be made only to students who have been accepted for admission to an accredited college or university for the academic year 1959-60. Students

Meeting the needs of ALL students—

college preparatory
pre-engineering, technical
high-school terminal

Seven textbooks in high-school mathematics offer a flexible program for non-academic, average, and superior students—prepared under the distinguished senior authorship of John R. Clark and Rolland R. Smith.

ALGEBRA ONE *and* **ALGEBRA TWO**
by Rolland R. Smith and Francis G. Langford, Jr.

PLANE GEOMETRY *and* **SOLID GEOMETRY**
by Rolland R. Smith and James F. Ulrich

TRIGONOMETRY
by Rolland R. Smith and Paul P. Hanson

BASIC IDEAS OF MATHEMATICS
by John R. Clark and Francis G. Langford, Jr.

MATHEMATICS FOR THE CONSUMER: Revised
by Francis G. Langford, Jr., Raleigh Schorling, and John R. Clark

A wealth of material for algebraic reasoning and computation—

Miller-Summers: **WORKBOOK FOR ALGEBRA ONE**

May be used to supplement any textbook for first-year algebra. It provides the extra practice and review needed by most students—on convenient perforated pages that simplify your task of correcting and marking papers—and extra incentive for neatness, legibility, accuracy, and proficiency. With 25 progress check tests.

WORLD BOOK COMPANY • Yonkers-on-Hudson, New York

may file applications for scholarships pending acceptance for admission to an accredited school. Scholarship applications should be filed by May 1, 1959. For further information write to Health Scholarships, 800 Second Avenue, New York 17, N. Y.

LANGUAGE INSTITUTES

Language Institutes will be established this summer at the University of Maine, the University of Michigan, the University of Colorado, and Louisiana State University with funds provided under the National Defense Education Act of 1958. Language Institutes are authorized under Title VI of the Act for the purpose of improving the teaching skills of elementary- and secondary-school teachers of modern foreign languages.

"With the establishment of these institutes, the Federal government and institutions of higher education have jointly taken an important step toward making up serious deficiencies in foreign language instruction in this country," U. S. Commissioner of Education Lawrence G. Derthick said. "The gravity of the problem is pointed up by the fact that the number of college graduates prepared to teach foreign languages declined 30 per cent between 1950 and 1957."

Federal funds for the language institutes include provision for stipends of $75 per week for each public school teacher in attendance and $15 a week for each of his dependents. All sessions will be free to the participants.

The summer language institute at the University of Maine will run from July 6 to August 21 and will provide instruction to 100 elementary- and secondary-school teachers in French, German, and Spanish. French, German, Spanish, and Russian will be taught to 100 elementary- and secondary-school teachers at an eight-week summer institute at the University of Michigan. This Institute will run from June 22 to August 14. The summer institute at Louisiana State University, to open June 14 and close August 8, will provide instruction for 40 teachers in French and for 40 teachers in Spanish. The summer institute at the University of Colorado will begin on June 22. Elementary- and secondary-school teachers interested in enrolling in the institutes should apply directly to the universities.

HELP FOR MATHEMATICS TEACHERS

Williams College, Williamstown, Massachusetts, at the request of interested secondary-school teachers through the organization of a Berkshire County (Mass.) Mathematics Teachers Association, is conducting two courses for two hours per week in Pittsfield. These courses, beginning last February, were especially designed for the needs of the teachers. The courses carry graduate credit.

A Summer Institute in the Humanities, under the auspices of the John Hay Fellows Program, will also be held at Williams College from July 2 to August 1, 1959. At least two additional Institutes in the Humanities will be held in the summer of 1960. Approximately thirty public high-school teachers and ten public school administrators will gather for a month of study and reflection. In seminars they will read and discuss several significant books; in small classes they will study literature, philosophy, and history. Under direction, they will take full advantage of the Sterling and Francine Clark Art Institute in Williamstown with its famous Renoir collection, the Williamstown Summer Theater, and the Berkshire Music Festival at Tanglewood. The teachers and administra-

. . . to meet the specific language teaching needs of George Reed Jr. High School, New Castle, Del.

another

MRI language laboratory

This 31-student position language-teaching unit — *complete* from Console to compartments — was designed, built and installed, by Magnetic Recording Industries.

Tell us *your* language-teaching needs. We will custom-tailor techniques and equipment to assure the most effective use of teacher's time and students' learning abilities.

Write today for planning form and descriptive brochure SSP-559.

Over a decade of Language-Laboratory experience

Magnetic Recording Industries

126 Fifth Avenue, New York 11 • ALgonquin 5-7250

MRI Language Specialists available in your area for Consultation

When writing advertisers mention THE BULLETIN

tors will come from high schools which have already showed interest in the full-year John Hay Fellowships. A few teachers from schools in the vicinity of Williams College will also participate. Co-directors of the Institute will be Professor Fred H. Stocking of Williams College and Dr. Charles R. Keller, Director, John Hay Fellows Program, 9 Rockefeller Plaza, New York City.

THE TEACHING OF RUSSIAN LANGUAGE

At the present time three classes of Russian I are being taught at Parma (Ohio) Senior High School. Out of 102 students who wanted to take Russian, eighty were selected for the program. The eighty students are a composite of juniors, sophomores, and seniors. Various methods of teaching the language have been introduced, including records, speakers, audio-visual, and tapes. A brief background of Russian history and culture is also presented.

The textbook used is *Simplified Russian* by Fayer with an accompanying workbook by Harsky. During the first semester, ten chapters were covered. The students have achieved competency in reading, writing, and speaking of all the material thus covered. Various tapes have been prepared by the students and these tapes will be exchanged with other schools who have a Russian program. Next year both Russian I and II will be offered.

INTERGROUP RELATIONS WORKSHOP

A research and field study oriented workshop on "Intergroup Relations" for social science majors, social workers, teachers, government workers, ministers, community organization workers, administrators, nurses, police, and hospital personnel will be offered from June 22 to August 1, 1959, by Western Reserve University. The program is designed to help participants broaden their understanding of the social and psychological forces operating in America which cause intergroup conflicts and to analyze methods proposed and used in dealing with these tensions. The workshop will be limited to forty students who qualify as graduate students. Some part and full-tuition scholarships are available. These have been donated to the University by the National Conference of Christians and Jews. Inquiries and registrations should be directed to Hollace G. Roberts, Director of Admissions, Western Reserve University, Cleveland 6, Ohio.

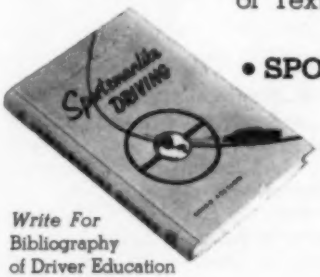
TEST PROBES STUDENT'S AWARENESS OF ROLE SCIENCE PLAYS

A new test for determining how students perceive science and scientists is now available from ETS for experimental use by teachers and social scientists. Called *Facts about Science*, the test looks like and is an achievement test, but it is unusual because it doesn't measure how well the student has learned the textbook facts of his science courses. Rather, it seeks to find out how well he understands the general nature of science, the special characteristics of scientists, and the way science fits into our society. To measure this understanding, *Facts about Science* presents the students with 80 three-choice items, concerning science and its role in society. The test is available to qualified social scientists who wish to use it for research and to high-school and college teachers who wish to use it as a guide in teaching. However, it should not be used for pupil selection or evaluation purposes. Specimen copies of the test booklet and manual may be ordered from the Research Division of Educational Testing Service, 20 Nassau Street, Princeton, New Jersey, at 75 cents per set.

For the **BEST** in High School
DRIVER EDUCATION

USE THE AAA *"PACKAGE"*

of Text Materials



Write For
Bibliography
of Driver Education
Materials, Aids

- **SPORTSMANLIKE DRIVING**
  THIRD EDITION
- **Teacher's Manual**
- **Project Workbook**
- **Objective Tests**
- **Driving Guides**

American Automobile Association 1712 G ST., N.W., WASH. 6, D.C.

A SMALL NUMBER

of experienced, successful teachers and other professional workers in the field of public education (grades K-12) are sought to meet expanding enrollments and the development of new and advanced programs. One or two positions calling for top-quality experienced administrators are also expected to open in the near future. Teachers with imagination and vigor are offered a thoroughly professional atmosphere in which to work, a modern school plant, and professional salaries of first rank ($4,600 to $10,000 in fifteen steps; elementary and secondary administrative salaries $8,000 to $13,500; appropriate initial placement). Situated in eastern Nassau County within one hour of New York City in a suburban and semi-rural area. Excellent transportation; first-rank recreational and cultural facilities easily accessible. Wide range of housing. A brief letter setting forth educational preparation and experience will elicit our immediate reply including preliminary salary data and other pertinent information. Write Director of Personnel, Central School District No. 2, Syosset, Long Island, New York. Mention publication.

SUMMER LIBRARY CONFERENCE

"The School Library and the School Curriculum" will be the subject of a 2-day conference planned by the Department of Library Service, University of Tennessee, Knoxville. Guest Director Miss Sue Hefley, Supervisor of the Materials Center, Webster Parish Schools, Minden, Louisiana, will be assisted by Miss Louise Meredith, Supervisor Instructional Materials and Libraries, Nashville 2, Tennessee, school librarians of the Knoxville area, and the summer faculty of the Department of Library Service. The conference will be held June 29-30, 1959.

PHYSICAL EDUCATION FACILITIES AND PROGRAMS

The Arkansas School Administrators Association recently completed a survey of the physical education facilities and programs in secondary schools administered by the Association. Replies were received from sixty nine (69) of the one hundred thirty six (136) schools to which the inquiry form was mailed. Some of the information gleaned from an initial study of the responses lead the Association to recommend to its members that they give particular attention to the following generalizations: (1) a majority of Arkansas high schools do not employ a physical education major to teach that phase of the program; (3) a greater shortage of physical education majors seems to exist among ladies than among men; (3) about one half of the schools reporting have fewer than 40 persons per physical education class and about half exceed that number; (4) a majority of the schools do not schedule physical education five days per week; (5) a majority of the schools do not provide the most desirable balance between physical education and health; (6) a majority of the students in the schools do not shower after each physical education class session; (7) most schools do not provide towel service for physical education classes; (8) few schools provide equipment for individual skills as the trampoline, flying rings, and gymnastic horse.

SCOUTING AIDS

The National Council of the Boy Scouts of America, New Brunswick, New Jersey, in response to requests from libraries for scouting material, has prepared a new leaflet recommending the most important Scouting materials for various age groups. It is entitled, "Boy Scouts Literature for Schools and Public Libraries." Herein are listed many aids that have been prepared to assist Scout leaders. Included are materials for Cub Scouting, Boy Scouting, and for Explorers. These Scout books and pamphlets have developmental functions and are highly readable. They are written at many levels. For the youth, there are books to aid their growth in Scouting skills. There is the merit badge pamphlet series that points up worthy occupational fields—of interest to maturing boys and guidance counselors. Still other books, geared to adult leaders' needs, discuss adult responsibilities.

THE PREVENTION OF JUVENILE DELINQUENCY

A study of delinquency-prevention measures and their effectiveness is presented as the March issue of *The Annals*, published by The American Academy of Political and Social Science. The range of programs has been considerably expanded in the last number of years, as shown in the way the work with delinquent youngsters and their parents is carried on, in the psychological and

The KEYSTONE Standard Overhead Projector
is available for purchase under the

National Defense Education Act

The Keystone Standard Overhead Projector is designed for the projection of Standard (3¼" x 4") Lantern Slides, Polaroid Slides, and Handmade Lantern Slides or, with appropriate accessories Tachistoslides (4" x 7"), 2" or 2¼" Slides, Strip Film, and Microscopic Slides.

It is useful—

In the Science Category with appropriate units of slides in Physics, Biology, General Science, Health, Hygiene, Physiography, and Elementary Science.

In the Mathematics Category in teaching Number Combinations tachistoscopically; Solid Geometry with Stereograms.

In the Modern Languages Category in teaching French and Spanish with Tachistoscopic Units.

Write for Further Information or a Demonstration by our Local Representative.
KEYSTONE VIEW CO., Meadville, Pa. *Since 1892, Producers of Superior Visual Aids*

Must reading for you and your school board

WHO RUNS OUR SCHOOLS?

By NEAL GROSS
Harvard University

School Management reports —

"Perhaps the most valuable service this book performs is to bring into the open the unfortunate hostility and lack-of-trust that prevail between administration and school board in so many districts. Were both parties in a given district to read this book *together*, it would certainly do much to improve relations. There is no preaching, no castigation. Gross presents facts. The readers can develop their own 'lesson plans'." *1958. 195 pages. $4.75.*

Send for an examination copy.

JOHN WILEY & SONS, Inc.
440 - 4th Ave. New York 16

Does Your Library Have a Speech Department?

The importance of the SPOKEN WORD is greater today than at any time in history. Leaders in all fields of endeavor are continually being requested to address associates, large audiences or to speak over the radio. To present and expound their ideas, plans and accomplishments in a forceful, understandable and interesting manner they must be proficient public speakers.

Indexed in the "Reader's Guide"
Since 1935
Issued 1st and 15th each month

One year $7.00 Two years $13.00
9 months $5.50
Sample copy on request

VITAL SPEECHES
33 West 42nd Street New York 36

sociological knowledge underlying the work, and in the methods employed in its evaluation. Much has been learned in recent years. The March *Annals* attempts to show delinquency-prevention programs both benefiting from this advancement and contributing to it.

The study is organized in four sections: statement of the delinquency-prevention problem, prevention measures through improving the environment, through treating the individual, and a proposal toward a unified community program. Some of the environmental projects reported are: "The Chicago Area Project" by Solomon Korbrin of the Illinois Institute for Juvenile Research; "The Work Camp Program" by Dr. Antoinette Fried, Director of Group Work and Recreation at the James Weldon Johnson Community Center; "A Boy's Club Program" by Dr. Roscoe C. Brown, Jr. and Dr. Dan W. Dodson of New York University Center for Human Relation Studies; "The Quincy Youth Development Project" by Dr. Paul Hoover Bowman of the University of Chicago; "The All-Day Neighborhood Schools" by Dr. Adele Franklin, Director and Founder; and "The Pre-delinquent Gang Project" by Ruth S. Tefferteller of the Henry Street Settlement.

The section on treatment of the individual includes: "Police-Social Agency Cooperation" by G. Lewis Penner, Director of the Juvenile Protective Association of Chicago; "A follow-up Report on the Cambridge-Somerville Youth Study" by Joan and William McCord, "Boston Delinquency Project" by Dr. Walter B. Miller, Director of Special Youth Program Research at the Whittier Street Health Unit; "Hyde Park Youth Project" by John M. Gandy, Director of Research and Planning of the Social Planning Council of Metropolitan Toronto; "Group Therapy Experiments" by Marion Stranahan, M. D., Chief Psychiatrist and Cecile Schwartzman of the Girl's Service League; and a report on "Treatment of Nonconformists in the Navy" by J. Douglas Grant, former Chief of the Research Division of the Navy Retaining Command at Camp Elliott, California, J. Douglas and Mrs. Marguerite Q. Grant.

In conclusion, Dr. Eva Rosenfeld of the Central Research Unit of the Jewish Board of Guardians presents a proposal for a unified community program. This Delinquency Prevention issue of the *Annals* may be obtained at $2 per copy by writing to Academy headquarters at 3937 Chestnut Street, Philadelphia, Pennsylvania.

FIVE NEW STANDARDIZED TESTS

The California Test Bureau, 5916 Hollywood Blvd, Los Angeles 28, California, has released five new tests for use in the secondary school. Coming at a time when testing, educational and vocational guidance, and identification of able students are occupying so much attention, these should be quite helpful to schools in their improvement program. Following is a brief description of each. The *California Analogies and Reasoning Test*, a 40-minute test containing 101 items which are presented in the form of analogies drawn from the field of natural science, mathematics, social science, and English literature. The test is almost entirely self-administering. Directions are read silently by the students. Responses may be recorded on the test booklet itself or on a machine-scoring answer sheet. It is designed for use at the upper secondary-school level.

The *California Study Methods Survey* is a self-report inventory designed to reveal the study methods and attitudes of the student. The need for such an instrument is made clear by the fact that many students perform well on

Now Available

HANDBOOK OF PRIVATE SCHOOLS
1958 Ed.—1248 pgs.—$10. copy

DIRECTORY FOR EXCEPTIONAL CHILDREN
facilities for handicapped, 3rd. Ed.—$6.

GUIDE TO SUMMER CAMPS AND SUMMER SCHOOLS
12th Ed.—$3.30, cloth; $2.20, paper

TOYNBEE AND HISTORY, on evaluation, $5.

PORTER SARGENT
educational publisher 45 years · 11 beacon st., boston

GROUP TERM LIFE INSURANCE
At Low Cost

For members of the National Association of Secondary-School Principals gainfully employed by an organized system of education

YOU CAN BENEFIT from the *preferred risk classification* of your profession through the low-cost Group Life Insurance Plan of this Association.*

YOU CAN PROVIDE, in the event of your death, a cleanup fund, a fund to finance your boy's or girl's college education, or a fund to take care of that mortgage payment.

YOU INTEND to meet these obligations if you live, but will you meet them if you do not live?

Detailed information will be furnished upon request. Write to the

NATIONAL ASSOCIATION OF SECONDARY-SCHOOL PRINCIPALS
1201 Sixteenth Street, N. W., Washington 6, D. C.

* All teachers in secondary education are eligible to membership in the National Association of Secondary-School Principals as associate members. All associate members receive all professional services and are eligible for life insurance under the Group Life Insurance Plan of the Association if gainfully employed by an organized system of education.

scholastic aptitude tests, yet earn relatively low marks in school achievement. The CSMS is made up of 150 questions which reflect the consistent difference in study methods and attitudes between high and low-achieving students. Three scales present this basic information: Attitudes toward School, Mechanics of Study, and Planning and System. A total score and a verification score are also provided. Either self-administration or group methods may be used in taking the *Survey*. Normally, one class period is sufficient for preliminary instructions, administration, and collecting materials.

The *Picture Interest Inventory* is designed to help an individual determine the pattern of his occupational interests. Research in the field of vocational counseling shows that many young people have made no vocational choice whatsoever. This often results in entering occupations for which they have little ability or interest. The PII, by helping an individual appraise his interests systematically, will aid him to choose an occupation in which he is likely to be both successful and satisfied. The PII can be completed in twenty to thirty minutes, and can easily be given within a regular class period. Scoring the test, either by hand or machine, is quick and uncomplicated. A profile page is offered to aid in the interpretation of results.

The California Test of Mental Maturity Technical Report, 32 pages, provides a comprehensive picture of the development of the *California Test of Mental Maturity* and the *California Short-Form Test of Mental Maturity* from the earliest edition, the 1957 restandardization, and statistical data which describe how the tests function.

The *S-O Rorschach Test* is designed to appraise and analyze vocationally significant temperament traits of the individual. The *Sort* is an assessment of temperament tendencies. The utilization of temperment patterns in educational-vocational guidance processes or in personnel selection enhances the likelihood of the individual's success.

SUMMER TRAVEL AND STUDY

Teachers interested in examining European educational facilities and philosophies firsthand, and who also desire to explore some of the fascinating centers of the Old World may be interested in California Teachers Association's (1408 King Street, Santa Cruz, California) seminar in Comparative Education for Summer, 1959. Scheduled for England, Holland, France, Germany, Austria, Russia, Spain, and Italy, the seminar offers five academic credits (graduate or undergraduate) through California Western University, San Diego, California. Cost of the 50 day trip is $995.00. Departs from New York on June 14.

Membership Secretaries of State High-School Principals Organizations

Affiliated with the National Association of Secondary-School Principals

Alabama Association of Secondary-School Principals (*White*)—*Frank N. Philpot*, Director División Secondary Education, State Department of Education, Montgomery, Alabama.

Alabama Association of High-School Principals (*Colored*)—*B. A. Outland*, Principal, Randolph County Training School, Roanoke, Alabama.

Arizona Association of Secondary-School Principals—*Ken Coffin*, Principal, Sunnyslope High School, 35 W. Dunlop, Sunnyslope, Phoenix, Arizona.

Arkansas School Administrators Association (*Colored*)—*E. H. Hunter*, Principal, Scipio A. Jones High School, Cedar at 10th Street, North Little Rock, Arkansas.

Arkansas Association of Secondary-School Principals (*White*)—*Frank L. Williams*, Principal, Junior High School, Hot Springs, Arkansas.

California Association of Secondary-School Administrators—*William N. McGowan*, 2220 Bancroft Way, Berkeley 2, California.

Colorado Association of Secondary-School Administrators—*Maurice W. Jessup*, Heath Junior High School, Greeley, Colorado.

Connecticut Association of Secondary Schools—*Alexander A. MacKimmie, Jr.*, Principal, Bulkeley High School, 470 Maple Avenue, Hartford 6, Connecticut.

Delaware Association of School Administrators—*Stephen Betze*, Assistant Principal, Bridgeville High School, Bridgeville, Delaware.

District of Columbia Association of Secondary-School Principals—*Boise L. Bristor*, Board of Education, Ross Administration Annex No. 1, Washington 9, D. C.

Department of Secondary-School Principals, Florida State Teachers Association (*Colored*)—*Gilbert L. Porter*, Executive Secretary, 449 West Georgia Street, Tallahassee, Florida.

Florida Association of Secondary-School Principals—*E. B. Henderson*, Secretary-Treasurer, Florida Education Association, 208 West Pensacola Street, Tallahassee, Florida.

Georgia Council of Secondary-School Principals (*Colored*)—*Mrs. Annie K. Maddox*, Principal, Attapulgus-Mt. Moriah High School, Attapulgus.

Georgia High-School Principals Association—*W. H. Adams*, Principal, High School, Toccoa.

Hawaii Association of Secondary-School Principals—*Arthur F. Mann*, Principal, Radford High School, 4361 Salt Lake Blvd., Honolulu, Hawaii.

Idaho Association of Secondary-School Principals—*Ellwood Gledhill*, Principal, High School, Buhl, Idaho.

Illinois Secondary-School Principals Association—*H. A. Dollahan*, Principal, Lawrenceville Township High School, Lawrenceville, Illinois.

Illinois Junior High-School Principals' Association—*Joseph E. Hickey*, Principal, Glen Ellyn Junior High School, Glen Ellyn, Illinois.

Indiana Association of Secondary-School Principals—*O. L. Van Horn*, 1083 Churchman Avenue, Beech Grove, Indiana.

Iowa Association of Secondary-School Principals—*Delmer H. Battrick*, Principal, Roosevelt High School, 45th and Center Streets, Des Moines 12, Iowa.

Kansas Association of Secondary Schools and Principals—*Glenn E. Burnette*, Principal, Junior High School, Manhattan, Kansas.

Kentucky Association of Secondary-School Principals—*James M. Deacon*, Principal, Lexington Junior High School, 4th and Limestone Streets, Lexington, Kentucky.

Louisiana Principals Association (*White*)—*Ben. F. Laborde*, Principal, High School, Marksville, Louisiana.

Louisiana Association of High School Principals (*Colored*)—*E. C. Land*, Principal, Lowery High School, Donaldsonville, Louisiana.

Maine State Principals Association—*Philip A. Annas*, Dept. of Education, State House, Augusta, Maine.

Maryland Secondary-School Principals Association (*White*)—*Stephen A. Lerda*, Principal, High School, Westminster, Maryland.

Maryland Society of Educational Pioneers (*Colored*)—*Ulysses S. Young*, Dean of Instruction, State Teachers College, Bowie, Maryland.

Massachusetts Secondary-School Principals Association—*Frederick H. Pierce*, Executive Secretary, 3 Broadway, Beverly, Massachusetts.

Massachusetts Junior High-School Principals Association—*Harry Finkelstein*, Principal, Garfield Junior High School, Revere 51, Massachusetts.

Michigan Secondary-School Association—*Cecil C. Elmore*, Executive Secretary, M.O. Box 480, Lansing 2, Michigan.

Minnesota Association of Secondary-School Principals—*William F. Carlson*, Junior-Senior High School, Northfield, Minnesota.

Mississippi Association of Secondary-School Principals—*John A. Johnson*, Principal Petal High School, Box 87, Petal, Mississippi.

Missouri Association of Secondary-School Principals—*Kenneth J. Smith*, Principal, Senior High School, Kirksville, Missouri.

Montana Association of School Administrators—*A. Ray Collins, Jr.*, Principal, Sweet Grass County High School, Big Timber, Montana.

Nebraska Association of School Administrators—*Merle A. Stoneman*, Administration Building 404, University of Nebraska, Lincoln 8, Nebraska.

Nevada Association of Secondary-School Principals—*R. G. Whittemore*, Principal, Yerington High School, Yerington, Nevada.

New Hampshire Secondary-School Principals Association—*Irvin H. Gordon*, Principal, High School, Marlboro, New Hampshire.

New Jersey Secondary-School Principals Association—*Charles W. Mintzer*, Principal, High School, Fair Lawn, New Jersey.

New Mexico Secondary-School Principals Association—*Ernest Stapleton*, Principal, Valley High School, Albuquerque, New Mexico.

European Branch of the NASSP—*Charles L. Latimer*, Secondary-School Coordinator, U.S. Army Dependents' Education Group, APO 164, New York, New York.

New York State Association of Secondary-School Principals—*Dudley C. Snyder*, Executive Secretary, 152 Washington Avenue, Albany 10, New York.

New York City High-School Principals Association—*Vincent McGarrett*, Principal, High School of Commerce, New York, New York.

New York City Junior High-School Principals Association—*Benjamin F. Davis*, Principal, Springfield Gardens Junior High School, Junior High School 59—Queens, Springfield Blvd. & Lucas Street, Springfield Gardens 13, New York.

New York City Vocational High-School Principals Association—*Jacob H. Raphael*, Principal, Thomas A. Edison Vocational High School, 170th Street near Jamaica Avenue, Jamaica 33, New York.

North Carolina Division of Principals of the NCEA—*C. E. Wike*, Principal, High School, Lexington, North Carolina.

North Dakota Principals Association—*Anne Gunderson*, Principal, High School, New Rockford, North Dakota.

Ohio High-School Principals Association—*Robert G. Winter*, Principal, Piqua Central High School, Piqua, Ohio.

Oklahoma Secondary-School Principals Association—*J. Frank Malone*, Principal, Northwest Classen High School, 2801 N.W. 27th & May Sts., Oklahoma City 27, Oklahoma.

Oregon Association of Secondary-School Principals—*John S. Conway*, 106 State Library Building, Salem, Oregon.

Pennsylvania Association of Secondary-School Principals—*S. P. Bomgardner*, Principal, High School, New Cumberland, Pennsylvania.

Rhode Island Secondary-School Principals Association—*Eldon D. Wedlock*, Principal, Scituate Junior-Senior High School, Trimtown Road, North Scituate, Rhode Island.

South Carolina Association of Secondary-School Principals (*White*)—*E. M. Morrow*, Assistant High-School Supervisor, State Department of Education, Columbia, South Carolina.

South Carolina High-School Principals Association (*Colored*)—*C. C. Woodson*, Principal, Carver High School, Spartanburg, South Carolina.

South Dakota Association of Secondary-School Principals—*George W. Janke*, Principal, Senior High School, 410 East 5th Avenue, Mitchell, South Dakota.

Tennessee Association of Secondary-School Principals—*Howard G. Kirksey*, Dean of Instruction, Middle Tennessee State College, Murfreesboro, Tennessee.

Texas Association of Secondary-School Principals—*W. I. Stevenson*, Principal, Milby Senior High School, Houston, Texas.

Texas Principals Association (*Colored*)—*Garfield Hill*, Principal, Weldon High School, Gladewater, Texas.

Utah Secondary-School Principals Association—*Lerue Winget*, Director of Secondary Education, 223 State Capitol, Salt Lake City, Utah.

Vermont Headmasters Association—*T. J. Whalen*, Principal, High School, Brandon, Vermont.

Virginia Department of Secondary-School Principals (*White*)—*Clarence H. Spain*, Principal, Binford Junior High School, 1701 Floyd Avenue, Richmond 20, Virginia.

Virginia Teachers Association (*Colored*)—*J. F. Banks*, Principal, Christiansburg Institute, Cambria, Virginia.

Washington Association of Secondary-School Principals—*George Hermes*, Principal, Irene S. Reed High School, 7th and Alder, Shelton, Washington.

Washington Junior High-School Principals' Association—*C. E. Halverson*, Principal, Libby Junior High School, East 2900 First Avenue, Spokane 31, Washington.

West Virginia Secondary-School Principals' Commission—*John F. Santrock*, Principal, Nitro High School, Nitro, West Virginia.

Wisconsin Association of Secondary-School Principals—*Harold L. Paukert*, Supervising Principal, Kohler Public Schools, 230 School Street, Kohler, Wisconsin.

Wyoming Association of Secondary-School Principals—*Merritt B. Jensen*, Principal, High School, Cheyenne, Wyoming.

enior
Grass
uild-
ring-
High
High
alley
U. S.
ative
High
ipal,
field
ipal,
naica
hool,
ock-
High
orth-
oma.
brary
ipal,
uate
row,
outh
ipal,
ipal,
truc-
nior
hool,
uca-
ont.
ipal,
ute,
e S.
bby
itro
ning
High

ORDER NOW!

The 1959 EDITION

OF

The College Blue Book

IS THE MOST COMPLETE WORK OF REFERENCE ON SECONDARY AND HIGHER EDUCATION IN THE UNITED STATES EVER PUBLISHED ANYWHERE

87 Sections (10 more than the 8th edition) including
Educational Television — Audio-Visual Education — Mental Tests
Scholarships (unrestricted)

Practically all sections have been vastly improved and expanded with the help of 74 Advisers: among the best informed Officers of Professional Organizations, University Officials and Professors, Secondary School Administrators, Government Officials, Foundation, Educational and Business Executives in the United States.

The more than a million data in this book (extensively cross-referenced) were submitted by an estimated 15,000 individuals representing approximately 8,000 Institutions, Organizations, and Government Agencies.

(Two printings of the 8th Edition were completely sold out and many orders could not be filled. Tenth Edition is scheduled for 1962.)

Cut Out This Convenient Order Card — No Postage Required

Postage Will be Paid by Addressee

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 744, YONKERS, N. Y.

The College Blue Book

P. O. BOX No. 311

YONKERS-ON-HUDSON, N. Y.

THE 1959 EDITION

OF

The College Blue Book

IS READY FOR PRINTING

WE ARE ACCEPTING

PRE-PUBLICATION ORDERS

POST-MARKED NOT LATER THAN MAY 31

at $18.00 per copy

($15.00 CASH — WITH ORDER)

(Two printings of the 8th Edition were completely sold out and many orders could not be filled. Tenth Edition is scheduled for 1962.)

SHIP To: CITY ..... ZONE ..... STATE .....

NAME .....

ADDRESS .....

Attention .....

..... Copies @ $18.00 ($15.00 per copy cash with order) | $ |

PRE-PUBLICATION PRICES

PRICES QUOTED INCLUDE POSTAGE AND HANDLING CHARGES

BILL To: (if different from "Ship To")

NAME .....

ADDRESS .....

CITY ..... ZONE ..... STATE .....

Purchase Order No. .....

Special Instructions .....

PRE-PUBLICATION ORDER CARD — The College Blue Book — NINTH EDITION 1959

NEW MATERIALS FOR ECONOMIC EDUCATION

Now Ready! C·A·S·E *Economic Literacy Series,* **No. 2**

CAPITALISM AND OTHER ECONOMIC SYSTEMS

132 pp., 1959

Just off the press, this long-awaited unit sets forth factually and concisely, with a minimum of historical background, the essential and most meaningful understandings on

- ✱ CAPITALISM
- ✱ COMMUNISM
- ✱ FASCISM
- ✱ SOCIALISM

Have you ordered this unit for use in your school yet? C·A·S·E *Economic Literacy Series,* **No. 1**

AMERICAN CAPITALISM: AN INTRODUCTION FOR YOUNG CITIZENS

128 pp., 1958

Already in its third printing and in use in more than 600 high schools in 47 states, this introductory unit presents simply and clearly

- ✱ basic economic principles
- ✱ how a free-market economy operates
- ✱ the nature and achievements of American capitalism

Order from

COUNCIL FOR ADVANCEMENT OF SECONDARY EDUCATION
1201 Sixteenth Street, Northwest Washington 6, D. C.

Single copy, 50 cents; 2-9 copies (same title) at 45 cents; 10 copies or more (same title) at 40 cents.

An Invitation

To Principals of Approved Secondary Schools

Does your school have a chapter of the National Honor Society founded by the National Association of Secondary-School Principals in 1921?

If your school does not have a chapter

And

If your school is accredited by one of the regional accrediting associations or if it has the highest rating of your state department of education,

You are invited to write for full particulars to:

Paul E. Elicker, Secretary

National Honor Society

1201 Sixteenth Street, N. W., Washington 6, D. C.